Current Science

Vol. XXIII] OCTOBER 1954 [No. 10

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SCIENCE AND HUMAN NATURE

THE dawn of the scientific era has been something of an adventure into the unknown, and no wonder each step that carries us forward is also fraught with fresh hopes and fears.

We all know where our curiosity has landed us: with advances in atomic physics which might be applied to devastate half the world, and if they were so applied would certainly make life in the other half extremely precarious. Our grandfathers were faced with scientific discoveries which were no laughing matter, for to many of them they spelled the end of all worthy human aims, but we face discoveries which might spell the end of all human aims, worthy or not.

In his Presidential Address to the British Association at its Oxford Meeting this year, Dr. Adrian is quite outspoken about the dangers which might arise from any future misuse of atomic energy. He has however shown that the hopes for the future can be bright provided we make a proper start right now in the study of the human factors which have led up to this situation. Thus, we can regret that atomic bombs are possible without regretting the discoveries that have led to them. Advances in natural science cannot avoid advancing the methods of warfare; they do so, when they make armies more healthy as well as when they increase the power of their weapons. But although the strategists have to think mainly of immense explosions and great devastation, it would be a mistake to suppose that these are the only dangers. Even if we can survive, then we must face the possibility that repeated atomic explosions will lead to a degree of general radioactivity which no one can tolerate or escape.

We are afraid, and rightly, because we cannot trust ourselves to act peaceably, because we know that unless we are ready to give up some

of our old loyalties, we may be forced into a fight which might end the human race. Our predicament then is the inevitable result of our curiosity and of the physical nature of the world that we live in. According to Dr. Adrian, it is time we made headway in learning as much as possible about the mental and physical causes which makes us behave as we do. A scientific study of human nature may well enable us to prevent its failures.

We do know of course an immense deal about human behaviour, from our own experience and from the accumulated wisdom of the past, but it is only in recent times that we have tried to check our knowledge by the mehods of natural sciences. The development of physical sciences dates from the time when direct observation and experiment were accepted as better guides than the principles which had seemed self-evident to the philosophers and the schoolmen. They were wise enough, but it was found that they could be mistaken. And so now we can look to the many branches of social science to make a dispassionate study of what actually happens in our society without regard to what might be expected to happen if we are to believe all that we have been taught. Indeed, one might say that the stage is nearly set for the new development and it might well be the most important scientific development in the present century. But why are we still reluctant to think well of it?

Probably the answer is, we are not yet convinced that the kind of observations that the social scientist can make will be sufficiently objective and sufficiently precise. Those of us who work in laboratories have a far easier task in selecting what we should observe, yet we know how difficult it is for us to select and observe truly. We have to school ourselves not to reject the exceptional result as worthless when it does not fit in with a cherished theory; we have to be continually aware of our fallibility even though we have all the figures and controls to keep us straight. With such experience before us we are loth to believe that the social scientists are more openminded than we are. The material they have to deal with seems to need an almost superhuman openmindedness combined with an almost superhuman power of selection, of seeing the wood as well as the trees in it. We feel that we should be lost in such a wood where everyone must feel the bias of his own upbringing and social ties, where there is so much that cannot be measured and may or may not be relevant and where there is rarely any opportunity to check the conclusions by experiment.

But to give way to such feelings would hardly seem to be proper. Perhaps we have forgotten how much we distrusted some new development near to our own field of science because it was unfamiliar and because we thought its backers claimed too much for it. We ought to remember that the now flourishing science of biochemistry was once distrusted by chemists as well as by physiologists. It is human nature for the guild of natural scientists to delay admitting a new member till he has paid his dues and satisfied the examiners of his competence in the craft.

At present there are many kinds of investigation grouped under the umbrella of social science: the groups seem to have little in common and few of them can put their results into figures, but it cannot be denied that scientists and laymen alike are becoming more and more aware of the value of social investigation and of the degree of certainty that it can bring. We can see too that the search for these facts can be conducted on reasonably scientific lines. It is therefore too early to be cautious in spending money on large-scale investigations. They are bound to be costly and those of the social scientists deserve not only the support of national and international funds. There is this kind of support for the subject already, but it is too important a plan to be left in the hot-house atmosphere of research institutes and UNESCO teams. It deserves to be in full contact with all the conservative and academic people in Universities, the lawyers and historians as well as the economists, biologists and statisticians.

It may be that the search into the innermost recesses of human nature calls for a scientific temper bordering on he sublime; but the search is no doubt worth making, as much for the dignity of science as for the larger purpose of serving the ends of humanity.

A DYNAMIC APPROACH TO TISSUE DIFFERENTIATION

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1. Early Views

THE problem of tissue differentiation has intrigued biologists of all ages. It would be refreshing, therefore, to commence an analysis with some of the earlier speculations. Spencer and Darwin postulated that the determiners of heredity circulated through the body. While the physiological units of Spencer were supposed to be alike, the gemmules of Darwin were as varied as the special cells they represented. Inheritance of acquired characters was conceded by both the investigators. According to Darwin environmental alterations get reflected in the gemmules produced by the tissues or organs. The method of transmission to the next generation was conceived to be by the collection of representatives of the different types of gemmules in the germ cells. A reversal of this process during ontogeny is a natural corollary. The products of division of embryonic cells are entered by gemmules representing the next stage of development which, by a process analogous to fertilization, determine their transformation into the type of body cell they represent in the adult organism (Herbert,[1] p. 54). In other words, during histogenesis, there is a "sorting out" of the hereditary particles. The views of these early biologists reveal the necessity felt by them to explain in a rational manner not only the origin of tissues but their integration in the scheme of organisation of an adult plant or animal.

Weismann who enunciated the germ plasm theory was critical of Darwin's views. He argued that if the characteristics of cells are determined by gemmules, and the gemmules representing all the cells are present in the zygote, it is easy to explain the specific orientation of tissues and organs because the gemmules are available whenever and wherever they are wanted (Herbert,[1] p. 55). But then the necessity for an explanation of the integrated series of phenomena seen during development would still be there. He speculated that many somatic mitoses may not be equational "but in reality qualitative (erbunglich)" (Sharp,[2] p. 482). The mechanism for "sorting out" of the hereditary particles was conceived by Weismann to be in the nucleus itself. It would appear that this suggestion may turn out to be rather prophetic.

Embryonic development, Conklin[3] observes, "consists of differentiations built upon preceding differentiations" (p. 593). Since development is initiated by fertilisation, evidences for differentiation may be available at or immediately after fertilization. *Is the source of differentiation the nucleus, the cytoplasm or both?* The discovery of the organ forming substances[3] in conjunction with the slow establishment of the dogma that all the cells of an organism have the same chromosome number[4] led to the view that it is the cytoplasm which plays a dominant role. It is this aspect which is emphasized in text-books. The argument is rather simple. Since histogenesis is not accompanied by a parallel differentiation of the gene complex, it has to be conceived that protoplasm with a given gene complex is capable of a wide variety of reactions in response to the changing local conditions during development. "In harmony with this interpretation is the fact that it is in the cytoplasm, rather than in the nucleus that most protoplasmic differentiation is manifested" (Sharp,[2] p. 489).

The above conclusion is based on the following considerations. The chromosome number is constant in all cells of an organism and hence there can be no change in the gene complex during development. The inference would be valid only if the facts are true. A direct analysis of the inference is precluded owing to the following reasons. (i) "The Mendelian theory has so far been concerned with heredity rather than development"[2] (p. 489). (ii) Many of the morphological characters used in genetic analyses are products of irreversible differentiation. (iii) There is the whole world of embryonic development between the gene complex in the zygote and the determination and expression of the characters they represent in the adult[2] (p. 489). The concept that no change occurs in the gene complex during ontogeny is, therefore, not based on any direct evidence. It could perhaps have been justified, and that only in an indirect manner, if the chromosome number is constant in all cells of an organism. But is the chromosome number constant in all cells of an organism?

2. Nuclear Phenomena Accompanying Tissue Differentiation

(i) *General.*—It has been recognised for some time now that the different tissues in the same

organism do not all have the same cytological make-up. "The statement made in most elementary accounts that all the nuclei of an organism contain the same number of chromosomes is only a first approximation to truth. Its frequent reiteration has, however, blinded many biologists to the fact, which has long been known (although its significance has only recently become apparent), that many of the differentiated cells of an adult organism are polyploid, that is to say, they contain 2, 4, 8, 16....times the diploid (2 N) number of chromosomes. This phenomenon is in general, only exhibited by the nuclei of cells which have differentiated so far that they have lost the power to divide by mitosis, unless reactivated to do so by some special treatment (*e.g.*, by growth-hormones in the case of plants)" (White,[5] p. 208).

(ii) Difference in the Number of Chromosomes between the Germ Line and Soma.—The earliest description of the difference in chromosome number between the germ track and soma is that of Boveri in *Ascaris*. The distinction starts even at the first cleavage, and becomes complete by the fourth. While in those cells destined to give rise to the germ track the chromosomes remain entire, in the others, they not only become subdivided into smaller pieces but their ends disintegrate in the cytoplasm[2] (p. 489). The suggestion that the chromosomes of the germ line of *Ascaris* are really polycentric[6] would not explain the loss of the ends of the chromosomes during the crucial stages of differentiation into germ and soma. Do the changes indicate a primary alteration in chromosome balance between the germ and soma ?

(iii) Difference in the Number of Chromosomes between the Germ Line Cells, Mitotic Indifferent Cells of Different Sexes and Some Differentiated Tissues.—A much more interesting example is *Sciara*.[7] There are generally 10 chromosomes in the spermatogonia and oogonia. The soma cells of the male showing mitosis have seven chromosomes while there are eight in the female. There is selective elimination of the paternal chromosomes excluding the X's and the 'limited' chromosomes during spermatogenesis. During the meiosis of the female, however, there is no irregularity. Immediately on fertilization, the zygote of *Sciara coprophila* contains one X derived from the egg pro-nucleus, two X's from the sperm and usually three L'S. This is said to be only a passing phase. "During the process of cleavage a number of the chromosomes are eliminated both from the somatic cells and from the germ line, so as to restore the chromosome sets characteristic of the adult tissues"[7] (p. 203).

Apart from the occurrence of the 'limited' chromosomes in the germ track alone and the difference in the number of X's observed in mitotically dividing male and female soma cells, further alterations are reported in the salivary cells. In *Sciara*, as in other insects, the salivary chromosomes are polytene. They however differ from those of *Drosophila* in the absence of a chromocentre[7] (p. 43). We thus see a variety of chromosome complexes in the same insect.

It may be that *Ascaris* and *Sciara* are isolated examples where there is a difference in chromosome number in the embryo between even the mitotically dividing cells which eventually develop into the germ track and soma. Usually, the indifferent embryonic or meristematic cells and those of the germ track have an identical chromosome constitution. The major difference is between the meristematic or embryonic cells and those constituting the differentiated tissues. The nuclear changes observed when an indifferent embryonic cell starts on the road to differentiation have been described under a variety of terms. These diverse phenomena could be arranged in an ascending order of increasing complexity.

(iv) Polysomaty.—The occurrence of tetraploidy as a stage during differentiation has been reported in the case of *Allium*[8] and *Mimosa*.[9] One of the characteristic changes during differentiation is the lack of synchronization between chromosome reproduction and cytokinesis. While the case of *Allium* and *Mimosa* typifies skipping of a single cytoplasmic division, thus giving rise to the tetraploid condition a higher stage of chromosomal duplication is shown by *Spinacia*.[10,11] These *polysomatic* cells which exhibit an ascending series of chromosome complexity[11] are the result of the breakdown in synchronization between karyo- and cytokinesis at regular intervals. Double chromosomal reproduction in the interval between two cell divisions appears to be the mechanism responsible for the production of polysomatic cells. Polysomaty is characterised by (*a*) the occurrence of cells with multiples of the diploid number amongst meristematic cells, and (*b*) the ability of such cells to go through the same phases as the meristematic cells during division.

(*v*) *Endomitosis and Polyteny.*—Whereas there is only a lack of synchronization between chromosome reproduction and cell division in polysomaty, cytokinesis is absent in endomitotic cells. The connected series of events like chromosome reproduction as well as the separation of the replicas occur in the absence of any condensation of chromosomes and within an intact nucleus. Naturally, the chromosomes remain 'fuzzy' throughout the whole process[5] (p. 209).

Endomitosis is characterised by the individual chromosomes remaining discrete. If the homologues fuse together, the products of their repeated division would give rise to the typical polytene chromosomes of the salivary gland cells of insects. An interesting case of the occurrence of both polyteny and polyploidy has been reported in *Lestodiplosus*.[5]

(*vi*) *Endopolyploidy.*—In many organisms, the occurrence of chromosomal replication within an intact nucleus has to be surmised from indirect evidence. In *Gerris* the heteropycnotic X chromosome has been utilized as a guide to judge the degree of polyploidy of the individual cells. By counting the number of heteropycnotic X chromosomes in the resting nuclei Geitler concludes that the giant nuclei in the salivary glands may be 512- to 2048-ploid.[5]

Often, the variation in the number of heterochromatic bodies in the resting nuclei render accurate evaluation difficult.[12] Such cells which usually do not divide could be stimulated to do so by the use of plant hormones and thus reveal their chromosome complexity.[13]

The nuclei of the epithelial cells of the ileum of *Culex* larvæ do not show any heterochromatic bodies.[14,15] But from the somatic reduction divisions, that they undergo during metamorphosis, it has been estimated that they may be 32- or even 64-ploid.

Assessment of the degree of endopolyploidy based on the number of heterochromatic bodies or relative sizes of the nuclei can only be tentative. Though there is said to be a rhythmic increase in nuclear size accompanying chromosomal duplication in *Gerris*, instances are on record where, in spite of the hypertrophy of the nucleus, it was presumed to be diploid because it had only a single heteropycnotic X chromosome.[11] The premise on which such conclusions are drawn is that there is an equal duplication of all the chromosomes of the mitotic complement. Is there any justification for such a belief?

(*vii*) *Differential Reproduction of Chromosomes.*—When a tissue becomes endopolyploid, it does not appear quite necessary that all the chromosomes of the mitotic complement should get duplicated to the same extent. In the nurse cells of the ovary of *Drosophila*, Schultz[16] reports—in an XXY form—that while the autosomes and the X chromosomes repeatedly reduplicate to give rise to the 512-ploid condition the Y chromosome is replicated only four times (p. 36).

(*viii*) *Alteration in the Structure of Individual Chromosomes.*—*Ascaris* is not unique in that at a critical stage of differentiation loss of chromosome ends occurs in some cells. In the cortical parenchyma cells of *Allium* loss of telomeres have been reported.[17] As a consequence the free ends of the chromosomes that come into contact are said to have a tendency to fuse.

The structure of the salivary chromosomes of insects has been under debate for the past two decades.[11] The technique which reveals the mid-prophase compound chromosomes of *Culex* uniformly stained shows the salivary chromosomes as consisting of alternating chromatic and achromatic discs. The removal of the achromatic regions from the salivary chromosomes, according to Berger[14] (p. 230), would make them chromatic throughout as well as restore the normal length ratio expected between them and the metaphase chromosomes. Can we consider that there has been a differential reproduction of the different regions of the same chromosome?

Compared to their length at mitosis, the heterochromatic regions are said to be much shorter in polytene chromosomes. Taking for example the X chromosome of *Drosophila melanogaster*, it is on record that while during mitosis about one-third of its length is heteropycnotic, the same region occupies less than one-tenth its length in the salivary nuclei[7] (p. 41).

There is no uniformity in the diameter of the euchromatin lying distributed along the length of the salivary chromosome. There are waist-like regions as well as localised swellings. The chromatic bands are said to be constituted by granules corresponding to the chromomeres of ordinary chromosomes. In favourable regions these granules could be counted and those of adjacent bands are connected by fine longitudinal threads. The number of chromomeres in adjacent bands may or may not be the same. Two threads converge on each

granule when there are only half the usual number of chromomeres in that particular band[7] (p. 38). During meiosis the chromomeres are known to differ in size.[6] But if there has been equal replication of all chromomeres, the number of granules in all bands of a salivary chromosome should be the same. Can we presume, therefore, that there has been differential reproduction of the granules constituting the different bands themselves?

(ix) *A Question of Terminology.*—The investigators who reported polysomaty,[11,14,15,18] polyteny, multiple chromosome complexes and endopolyploidy never made any serious attempts to relate these phenomena to tissue differentiation. As would be evident from the preceding pages it is possible to arrange the different cytological changes observed during histogenesis in an evolutionary scale. The most complex condition where there is not only an absence of cytokinesis but also visible evidence for the reproduction of most of the chromosomes could be derived from polysomaty with periodic lack of synchronization between chromosome reproduction and cytokinesis. Polysomaty, endomitosis, polyteny and endopolyploidy could, therefore, be considered as mere variations on a basic theme. The striking feature in all these phenomena is the replication of all or many of the chromosomes. Histogenesis is a characteristic of higher organisms whether they be haploids, diploids or polyploids. And, it is during histogenesis that one meets with a variety of cytological phenomena. Clearly, they constitute a different order of changes unrelated to polysomy or polyploidy. It is to avoid confusion that Subramaniam[19,20] suggested the use of the general term *endopolyploidy* to refer specifically to the cytological phenomena observed during differentiation.

3. Embryonic and Differentiated Cells

The analysis presented above reveals the desirability for a revival in a general way of the old Weismannian concept of *germ* and *soma*. This becomes imperative when it is realised that in *Sciara* there is a difference in the chromosome number between cells of the germ track and the indifferent cells of the soma, though both show mitosis. So long as there was an apparent justification for the belief that all cells in the same organism had the same chromosome number, there was no imperative necessity to differentiate between germ and soma. It is in the above context that one has to view the geneticist's limitation of the term "germ plasm" specifically to chromosomes[2] (p. 485). Now that ample proof regarding the invalidity of the law of constancy of chromosome number is available,[4,12] a revival of an analogous but fundamental distinction becomes necessary.

Admittedly while the instance of *Sciara* would suggest a rigid classification, it would be preferable to broaden it in view of the general identity in chromosome number between the indifferent cells of the germ track and the embryonic or meristematic cells. The disintegration of the primordial germ cells and the origin of the functional germ track from the indifferent cells of the early embryo are regular developmental phenomena in some insects[2] (p. 490). The number and behaviour of chromosomes are identical during *normal mitosis* whether it be in a cell of the embryonic tissue or the germ track. So long as they do not undergo any differentiation, mitotic cells are potentially immortal.

Lack of synchronization between chromosome reproduction and cytokinesis produces two distinct types of transformation. Functional germ cells *come into being as a result of chromosome reproduction being out of step with cytokinesis*[6] (p. 88). On the other hand, *suppression of cytokinesis to varying degrees*, during histogenesis, results in conditions described as polysomaty, endomitosis, polyteny and endopolyploidy.[21] We see thus that specialized cells whether they be the sperm or ova or those constituting the diverse tissues of an organism are *products of differentiation in opposite directions*. They resemble one another in that they have only a limited span of life. It would be desirable, therefore, to classify cells into two broad categories, *viz.*, (i) EMBRYONIC, and (ii) DIFFERENTIATED. Tissues may contain embryonic cells for purposes of replacement of those lost due to senility and death.

4. Polyploidy and Endopolyploidy

Once the necessity for such a primary distinction is grasped, it would be obvious that polyploidy and endopolyploidy are unrelated phenomena. It is rather interesting to recall that Winkler[4] attempted such a distinction as far back as 1916. "The constancy of chromosome number is safeguarded even when there is vegetative reproduction, since plants grow with their growing points which, by definition, are always embryonal.....We therefore come to the view that the regular occurrence of polyploid cells in the somatic tissues of higher plants by no means refutes the law of constancy of chromosome number but must be

expected in view of the importance of the chromosome number for cell size"[1] (p. 13).

Apparently Winkler was trying to emphasize the salient fact that separation of diploids from polyploids is based on investigations of chromosome number in embryonic cells. Embryonic cells in diploids as well as polyploids are capable of differentiation into germ cells or as components of various tissues. And it is during tissue differentiation that the cells become endopolyploid. There is thus no reason to consider that polyploidy and endopolyploidy are interchangeable phenomena. Nor can it be assumed that viable polyploid types could be derived directly from endopolyploid cells.

The cytological events during histogenesis, therefore, can have a significance only to the origin of tissues and not, as in the case of polyploidy, to the hereditary make-up of the organism.

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FRESH SOURCES OF SELENIUM

THERE is no known deposit of selenium as such which is worth mining. The element occurs with sulphide ores, and most of it is obtained as a byproduct in the electrolytic refining of copper. The "anode slime" formed in the process contains a fairly high proportion of selenium.

The U.S.A. is the biggest producer of selenium, all of it from this process, but its supplies are still not enough for its own industry, and it has to import more of it. Most of Great Britain's supplies of selenium come from Canada, again from copper refining plant. There are small quantities of selenium on the market which come from Sweden and Japan, but these are high priced compared with the Canadian selenium.

There is a possible source of selenium in Great Britain which is now being investigated by the Chemical Research Laboratory as a result of a survey of the selenium problem by the Intelligence Division of the Department. Iron sulphide, or pyrites, is used in Great Britain in the manufacture of sulphuric acid. Like copper sulphide, it contains selenium. Flash roasting of pyrites is one of the processes which is used to avoid using sulphur as a raw material. The process is fairly new, but its use is expanding and it may produce quantities of selenium which would be worth recovering. The selenium is concentrated in the wastes, dusts and muds from the roasting plant. Little is yet known of the economics of recovery, but waste material from three plants have been examined at the C.R.L. The materials from one plant contain sufficient selenium to justify the hope that recovery would be worthwhile. As in copper refining the problem is to develop a method which will not interfere with the primary object of the process and be cheap enough and simple enough to make selenium production pay.

The potential yield from this source will run into tons, a valuable addition to present supplies. One of the speculative things about recovery is that pyrites varies so much in its content of selenium. The C.R.L. investigation shows, however, that the possibilities of augmenting supplies of this extremely valuable element in this way are well worth serious consideration.

LUNAR RAINBOWS

THE characteristics of solar rainbows, both primary and secondary, are well known and also widely appreciated. The fact that rainbows at night time due to moonlight also exist is, however, not so widely known.

On the night of the 16th of July 1954 at Allahabad there was a sharp shower at about 8-30 p.m. The sky was covered by scattered dark clouds and the moon appeared to be remarkably brilliant whenever she had the opportunity of getting out of the clouds. The elevation of the moon by visual estimate was about 30° above the eastern horizon. Due west there suddenly appeared a fairly brilliant semi-circular arc, broad and exhibiting the usual colour sequence found in solar rainbows; only the colours were rather faint. Soon, another semi-circular arc sprung up on the outer side of this. It was rather faint and colours could hardly be seen in it.

These arcs could at once be explained as the primary and secondary rainbows caused by the light coming from the moon, in other words, they were lunar rainbows. The secondary rainbow soon vanished but the primary one maintained itself in intensity and width for full 45 minutes. After this time the intensity of the primary bow went down rather at a rapid rate and soon the bow vanished.

During my thirty-two years of scientific career I have never witnessed any lunar rainbows nor have I any recollection of having seen a report about these in India.

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BLOOD GROUPS AND DISEASE

STUDIES of the relation between blood groups and diseases (other than transfusion reactions) may be divided into two main classes: those concerned with the blood groups only of affected individuals, and those concerned with the blood groups of both mothers and their fœtuses in relation to the diseases of either or both. Restricting consideration to the classical or ABO blood groups, a recent issue of the *British Medical Journal* (1954, August 7, pp. 315, 321 and 323) contains three papers on the relation of blood groups to disease. All of them set out the results of statistical studies on the blood group frequencies in selected classes of sufferers as compared with those in the general population. The relative frequency of neoplastic diseases and of peptic ulcer in persons of different blood groups almost certainly depends entirely on individual susceptibilities: any persistent effort of maternal antibodies in the adult life of the offspring is extremely unlikely.

Professor Ian Aird and his colleagues have shown that persons of group A have a greater susceptibility to carcinoma of the stomach than those of other blood groups, and these authors have brought to light the even greater relative susceptibility of persons of group O to peptic ulcer. The fact that two of the diseases which show an excessive susceptibility in persons of a single blood group are connected with the stomach suggests that the secretion of blood group substances by the stomach may be involved. About 75 per cent. of persons secrete their particular blood group substance in both saliva and gastric juice, and the ability so to secrete is genetically determined. It is important, therefore, to know the secretor status as well as the blood group of persons suffering from the various diseases. It is important, furthermore, to try to determine whether the one blood group substance is actively pathogenic or whether the other substances are protective. Such knowledge may ultimately prove to be of value for prophylaxis and treatment of the diseases concerned.

Whatever may prove to be the reasons for these connexions between blood group and disease, they have profound implications for human evolution, since they provide part, at least, of the means long predicted by Sir Ronald Fisher and Dr. E. M. Ford whereby an active equilibrium may be maintained over many generations between the frequencies of the different blood groups.

SPECIFIC INHIBITION OF HYPOTHALAMIC PRESSOR RESPONSE

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WHILE investigating the central actions of chlorpromazine (chloro-3-dimethyl amino-3' propyl-10 phenothiazine; Largactil; Megaphen; 4560 R.P.), Dasgupta and Werner[1] noted a suppressive action on the rise of blood pressure elicited by electrical stimulation of hypothalamic or medullary pressor areas; the effect was most marked following intravenous administration of the drug to diencephalic (non-anæsthetised) animals and was observable in a low dosage range in which the drug is completely devoid of any peripheral action. Although a certain similarity was found between chlorpromazine and morphine as regards the suppression of some signs of "sham rage" in diencephalic animals,[2,3] a marked difference apparently exists, in so far as the latter drug does not affect responses obtained on direct electric stimulation of the hypothalamus.[4] Other drugs with central depressant actions have not yet been investigated under comparable conditions: it was therefore not possible to decide whether suppression of direct excitability of pressor areas in the hypothalamus is characteristic for chlorpromazine only or common also to other drugs with central depressant activity.

For the present series of experiments, pethidine and pentobarbitone have been selected. The methods of investigation were the same as in the experiments with chlorpromazine referred to previously[1]: cats were decorticated under ether anæsthesia, artificially ventilated (in muscle paralysis through decamethonium) and unipolar electrodes were inserted by means of a Horsley-Clark Stereotaxic apparatus, so that pressor areas of hypothalamus and medulla oblongata could be stimulated (square wave impulses, 100/per sec.; 0,5 m. sec. pulse duration); the pressor responses were recorded by means of a Hg-manometer, connected with the common carotid artery. In some experiments, pressor effects resulting from electrical stimulation of the left splanchnic nerve (dissected from the dorsal approach) were also recorded in order to ascertain, whether and to what extent peripheral (*e.g.*, ganglionic blocking[5-7]) effects could account for the observed action of the drugs on the centrally induced pressor responses. Only such experiments are reported in which the pressor effects resulting from central and peripheral stimulation were of equal height and well reproducible in control periods.

The results with pethidine are summarised in Table I and one typical experiment is illustrated in Fig. 1.

TABLE I

Results with pethidine in diencephalic animals

No.	Dose mg./kg.	Fall of B.P.† mm. Hg	Hypothalamic stimulation	Medullary stimulation	Splanchnic stimulation	Spontaneous waves
1	1, 0	10	A	..	..	A
2	3, 0*	40	A	..	−30%	N
	5, 0	50	..	..	−50%	
3	1, 0	50	A	..	+10%	..
	2, 0	90	A	..	−40%	N
	3, 0	105	A	..	−60%	
4	0, 7	50	..	−20%	..	N
	3, 7	80	..	−90%	..	
5	2, 2*	20	A	U	..	A
	4, 2	70	A	A	..	A
6	0, 7	70	..	−10%	U	..
	2, 7	80	..	−25%	−20%	N
	4, 7	80	..	−60%	−50%	
7	2, 0	20	..	−15%	U	N
	4, 0	60	..	−60%	−20%	
	5, 0	70	..	−75%	−50%	
8	1, 0	30	A	−10%	..	A
	2, 0	70	A	−25%	..	A
	3, 5	60	A	−50%	..	A

* Lower dose was not tried † With reference to initial pressure A = abolished, U = unaltered, N = not present.

It is apparent from Table I that pethidine can in a certain dosage range abolish hypothalamic pressure responses under these experimental conditions without reducing the blood pressure rise caused by stimulation of the splanchnic nerve (see also Fig. 1); pressor responses resulting from medullary stimulation are about equally sensitive for the inhibition through pethidine as the responses obtained by splanchnic stimulation. Spontaneous blood pressor waves which are rather frequently found in diencephalic animals and which usually are of an amplitude of 50-70 mm. Hg, are however, as effectively suppressed by pethidine as the effects of hypothalamic stimulation. The different sensitivity of hypothalamic and medullary pressor areas is particularly obvious

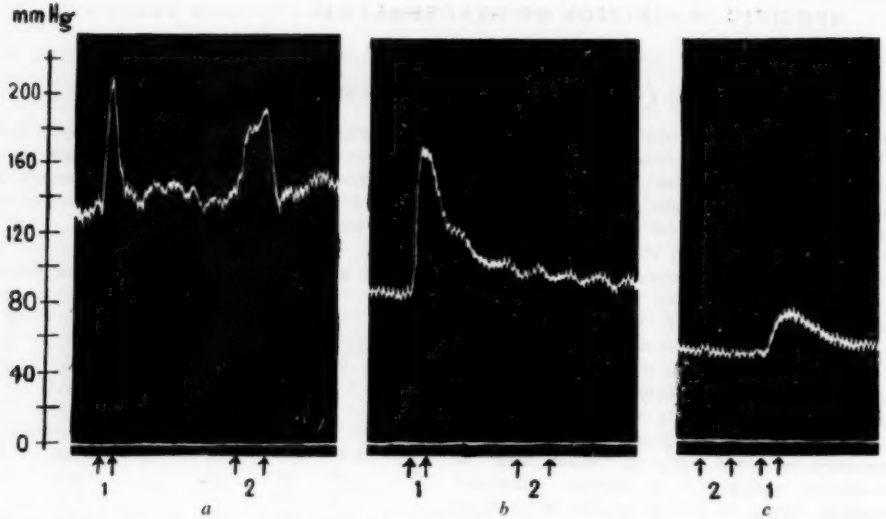

FIG. 1. Blood pressure record of Exp. No. 3 (see Table I). 2. Stimulation of hypothalamic pressor area. 1. Stimulation of left splanchnic nerve.

(*a*) Control responses. (*b*) 5 min. after intravenous injection of 10 mg./kg. pethidine. (*c*) 5 min. after intravenous injection of additional 3 mg./kg. pethidine (2 mg./kg. pethidine were administered 7 min. before that, the total dose difference between record *b* and *c* is therefore 5 mg./kg.).

in Experiments Nos. 5 and 8 (see Table I), where pressor responses of equal height were elicited alternatively from the two areas of stimulation, but only the hypothalamic responses were suppressed in a certain dosage range.

The considerable fall of blood pressure obtained already after low doses of pethidine is striking in these experiments and apparently due to the high blood pressure which the diencephalic animals showed to start with, presumably as a result of hypersecretion of pressor amines from the adrenal medulla[8], it is obvious that the central blocking effect of pethidine on the hypothalamus will appear more effective against the background of such high sympathetic activity induced by decortication.

The results with pentobarbitone were less conclusive: the hypothalamic pressor response was in three experiments abolished by doses of 3,0 to 5,0 mg./kg.; however the blood pressure rise caused by stimulation of the splanchnic nerve in the same experiments was also considerably reduced: a specific action on hypothalamic pressor areas cannot therefore be demonstrated for pentobarbitone under such experimental conditions.

Central depressant drugs apparently differ in their pattern of activity in so far as some of them can be shown to suppress the direct excitability of hypothalamic pressor areas in diencephalic animals, in doses which are devoid of peripheral effects (*i.e.*, chlorpromazine, pethidine); a difference exists, however, between these two drugs in so far as chlorpromazine affects both the excitability of hypothalamic and medullary pressor areas to a similar extent whereas pethidine appears to affect the latter, if at all, to a lesser extent. In the case of pentobarbitone, central actions on the hypothalamus cannot be demonstrated under the conditions of these experiments, since peripheral (presumably ganglionic blocking[6,7]) actions can fully account for the observed results.

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2. Mukherjee, K. L. and Werner, G., *Arch. int. Pharmacodyn.*, 1954, **97**, 149.
3. Wikler, A., *J. Pharmacol. exp. Ther.*, 1944, **80**, 176.
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OSCILLATIONS IN NITROGEN GLOW DISCHARGE

A VERY interesting account of the nature of electrical oscillations produced in the positive column of the discharge tube, has been given by J. J. Thomson (*Phil. Mag.*, Vol. XI, Jan.-June, pp. 697, 1931) and the present work is on the same line as Thomson's. The various types of luminous oscillations which reveal themselves in the rotating mirror as some lines, are called by J. J. Thomson as α, β and γ lines. He attributes the origin of the α-lines to a sort of explosion taking place in the discharge at regular intervals. The β-lines are due to the intermittence in the positive column and the γ-lines represent the ionic vibrations which are set up by the disturbances caused by explosions which give rise to α-lines.

It is found that the impurities in the gas, increase in the pressure of the gas and current make the discharge highly unsteady. The lower limit of current for a steady discharge is found depending on the pressure in the discharge tube. The lower the pressure, the smaller is the strength of the current required to maintain a steady glow.

The frequency of the lines was found by a revolving mirror. As the number of lines is usually too large to be counted in the whole field of view, a reviewer with a small field of view was used for observing them. By this method the order of the frequencies of α and β were found to be 3×10^2 cycles and 10^3 cycles respectively.

The high frequencies were measured by a Heterodyne wavemeter.[1] The coupling coil is placed near the field of the transmitter and the condenser is adjusted till the heterodyne beat is heard in the telephones. The wavelength of the wavemeter then coincides with that of the transmitter and the actual wavelength is obtained from the calibration chart. The values of the frequencies found were slightly different at different stages. Five

different frequencies have been found which are given in Table I.

TABLE I

Frequencies observed in the discharge

Discharge Potential in volts	Pressure in mm.	Frequencies in Mc./s.				
5600	0·015	0·236	0·595	0·735	1·625	2·27
2900	0·029	..	0·61	..	1·625	2·25
2000	0·04	..	..	0·735	1·66	2·56
980	0·1	0·236	..	..	1·69	2·45
	Mean	0·236	0·603	0·735	1·65	2·38

An oscillograph was also used to study the voltage oscillations. As a suitable voltage divider to bring out the voltage across the discharge tube to within 450 volts (the highest voltage that can be applied to the oscilloscope input) was not available, direct observations were not possible. An indirect method which can give a qualitative picture of the discharge tube was used. Current oscillations were also studied. The voltage developed across the resistance included is applied to the horizontal plates of the oscilloscope. The patterns on the screen indicate the variations in the current of the discharge tube circuit. The frequencies of the different types of oscillation were measured with the oscilloscope and were found to be nearly the same as that obtained with wavemeter. The frequencies of the striations which are a common feature of the positive column of a glow discharge were found to vary from 40 to 800 cycles.

I am grateful to Dr. B. Dasannacharya for guidance.

Physical Laboratory, M. SAKUNTALA.
Banaras Hindu University,
May 21, 1954.

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CALCULATION OF THE DIPOLE MOMENTS OF TRI-SUBSTITUTED BENZENES

A GENERAL method is worked out for the theoretical calculation of the dipole moments of 1 : 2 : 4-tri-substituted benzenes following the lines of Smallwood and Herzfeld[1] for the di-substituted benzenes. The total moment of a tri-substituted benzene compound comprises of (1) the vector sum of the moments of the primary dipoles, (2) the mutual induction of the three primary dipoles on one another, and (3) the moments induced in the -CH and the -C-C bonds of the hydrocarbon residue by the primary dipoles. A correction is also applied for the dielectric constant of the internuclear space as has been suggested by Le Fevre.[2]

The final equation giving the dipole moment M of the compound is given as

$$M = \sqrt{M_x^2 + M_y^2} \qquad (1)$$

where

$$M_x = 2{\cdot}3652\,\xi_1' + 1{\cdot}07456\,\eta_1' + 1{\cdot}3171\,\xi_2' + 0{\cdot}2809\,\eta_2' + 2{\cdot}3326\,\xi_3' + 1{\cdot}01432\,\eta_3'$$

$$M_y = 0{\cdot}9254\,\xi_1' + 0{\cdot}7710\,\eta_1' + 0{\cdot}2809\,\xi_2' + 1{\cdot}9135\,\eta_2' + 1{\cdot}0143\,\xi_3' + 0{\cdot}8454\,\eta_3'$$

ξ's denote the X-components and η's denote the Y-components of the moment as modified by the induced effects.

The values calculated for five compounds for which experimental data are available, are given in Table I.

TABLE I

Compound	$M_{vect.}$	$M_{eq.\,(1)}$	M′	$M_{obs.}$
1 : 2 : 4-Trichloro-benzene	1·64	1·24	1·40	1·25[3]
2 : 4-Dinitrochloro-benzene	3·26	3·14	3·19	3·0 ± 0·1[4] 3·29[3]
2 : 4-Dinitrobromo-benzene	3·26	3·72	3·54	3·1 ± 0·1[4]
2 : 4-Dinitroiodo-benzene	3·31	4·92	4·29	3·4 ± 1[4]
2 : 5-Dichloronitro-benzene	3·75	3·31	3·48	3·45[3]

The first column ($M_{vect.}$) gives the moment in Debye units obtained by the simple method of vectorial addition, the second ($M_{eq.\,(1)}$) gives the value calculated according to Eq. (1) and the third (M′) gives the value when the correction for the dielectric constant of the internuclear space is also incorporated. The difference between $M_{vect.}$ and $M_{eq.\,(1)}$ which gives the induced effect is multiplied by the factor $\frac{\epsilon+2}{3\epsilon} = \frac{4{\cdot}4}{7{\cdot}2}$ (ϵ the dielectric constant of the internuclear space being taken as 2.40[2]) to give the actual induced effect. This is added algebraically to $M_{vect.}$ to get the value under the head M′. The last column ($M_{obs.}$) gives the observed value.

Details of the calculation and the discussion of the values will be published elsewhere.

Physics Dept., D. V. G. L. NARASIMHA RAO.
Andhra University,
Waltair,
July 23, 1954.

1. Smallwood and Herzfeld, *J.A.C.S.*, 1930, **52**, 1919.
2. Le Fevre and Le Fevre, *J.C.S.*, 1937, 196.
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4. Lutgert, *Ibid.*, 1932, **17B**, 460.

ULTRASONIC VELOCITY AND MOLECULAR VOLUME

It was shown by Rao[1] that the thermal coefficient of velocity of sound v in organic liquids is about three times the thermal coefficient of density ρ. The relation can be written

$$v^{\frac{1}{3}} V = R \qquad (1)$$

Here R is a constant independent of temperature and V is the molecular volume M/ρ. R was found to compare favourably with the parachor as far as its additive properties were concerned. It was shown that plot of R against M resulted in a series of straight lines for each homologous series represented by the equation

$$R = \alpha M + \beta \qquad (2)$$

α was shown to have the same value (14) and β was found to be different for different homologous series. Parthasarathy[2] found that by plotting $v^{\frac{1}{3}}/\rho$ against 1/M a family of straight lines is obtained, satisfying the equation

$$v^{\frac{1}{3}}/\rho = A + B/M \qquad (3)$$

where A is 13·56 which is the same for all series and B varies from series to series. Equations 2 and 3 are algebraically the same.

The proof of the constancy of α in (2) and A in (3) is simple. If R_1, R_2 are the values of R for two successive members of homologous series, then the difference in the value of R divided by 14, the molecular weight of CH_2 gives the value of α or A which according to Rao is 14 and 13·535 accordnig to Lagemann, McMillan and Wolsey,[3] and 13·56 according to Parthasarathy. Rao took the average value of R = 195 for a number of series including alcohols. It would therefore appear that more measurements of the velocity of sound on a larger number of series are needed to check up the value of the difference in the value of R for two successive members. It is very easy to extend this result to the case of parachor on similar grounds. The constancy of A or α when $v^{\frac{1}{3}}/\rho$ is plotted against η is to be traced to the same cause, namely, that R is additive. But the fact remains that such a relation holds only for one temperature, as η varies considerably with temperature.

The quantity R is an additive function as the parachor is. It is known that the molecular critical volumes are additive. Since R is independent of temperature and has the property of being additive, one naturally thinks of comparing R with V_c. It was shown by Rao[4] that the ratio of R to V is a constant for most substances. We will be then comparing quantities which are not dimensionally the same. Instead of expressing R in terms of length, mass and time, if we build up a dimensional equation in terms of energy, length and mass then R could be expressed as $(\text{energy})^{\frac{1}{3}}$ $(\text{length})^3$ and $(\text{Mass})^{-\frac{1}{3}}$. Since R is nearly proportional to V_c any departure from the constancy of the ratio is to be attributed to other factors not taken into consideration. Since we are considering the molecular critical volume, the other corresponding quantities will be the critical temperature, and critical pressure. Either of these could be used to build up the equation. Since energy is directly proportional to the temperature we replace the energy term by θ_c. Thus R can be expressed

$$R = R' \left(\frac{\theta_c}{M}\right)^{\frac{1}{3}} V_c \qquad (4)$$

The constancy of R' is very much better than the constancy of the ratio R/V_c as found from an examination of 30 substances. From the known values of θ_c, V_c for any liquid and from the mean value of R', the R value for any liquid could be found and hence the velocity of sound in the liquid at any temperature knowing its density at that temperature. In the intermolecular potential used by Lennard Jones and his collaborators the quantities ϕ and r_0 which are constants of energy and length characteristic of the molecule are found proportional respectively to θ_c and $V_c^{\frac{1}{3}}$. We may, therefore, write equation (4) as follows:

$$R = R'' \left(\frac{\phi_0}{M}\right)^{\frac{1}{3}} V_c \qquad (12)$$

where R'' is a temperature-independent constant, the same for all substances. From the interpretation of r_0^3 as a collision volume we would expect R to be additive when more complicated molecules are built up as the contribution of the term $(\phi_0/M)^{\frac{1}{3}}$ is indeed small. The utility of the function R in studying molecular association has been pointed out by Lagemann[5] and his collaborators. The additive property could be extended to solution as was first pointed by Rao in 1940.[1] Starting from the equation of state of the type

$$Pv + f(v) = \frac{\gamma_m}{\lambda} E \qquad (5)$$

after Van Laar,[6] we can show by a little calculation that the adiabatic compressibility β_ϕ can be put as

$$\beta_\phi = 1 \Big/ \left[P\left(1 + \frac{\gamma_m}{\lambda}\right) + \frac{\gamma_m}{\lambda} \frac{f(v)}{v} + f'(v)\right] \qquad (6)$$

If we neglect P the external pressure with reference to the internal pressure

$$\beta_\phi = 1 \Big/ \left[f'(v) + \frac{\gamma_m}{\lambda} \frac{f(v)}{v} \right] \qquad (15)$$

which is a pure function of the volume. In particular Rao's equation is obtained if $f(v)$ is assumed to be of the form λ/v^n where $n = 6$.

Further details will be published elsewhere.

Meteorological Observatory, M. RAMA RAO.
New Delhi,
August 10, 1954.

1. Rao, *Curr. Sci.*, 1939, **8**, 510; *Ind. Jour. Phy.*, 1940, **14**, 109. *Nature*, 1941, **147**, 268; *J. Chem. Phy.*, 1941, **9**, 682. *Ultrasonics*, by Vigoureux, 1950. *Ultrasonics*, by E. G. Richardson.
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MICROLITHIC INDUSTRY OF KIBBANAHALLI, MYSORE STATE

IN and round Kibbanahalli, a large number of paleolithic artifacts were discovered by Prof. Sampath Iyengar and Prof. L. Rama Rao in 1924 and 1928 respectively. At the foot of the ridge, there are a number of small spurs, extending towards the cultivated lands of the village of Kibbanahalli. The microliths along with considerable waste material were discovered by Mr. and Mrs. Allchin, of the London University Institute of Archæology, who visited that area in 1951 at the suggestion of the writer. Further visits to the site in 1953 by the writer resulted in the discovery of a few more microlithic artifacts.

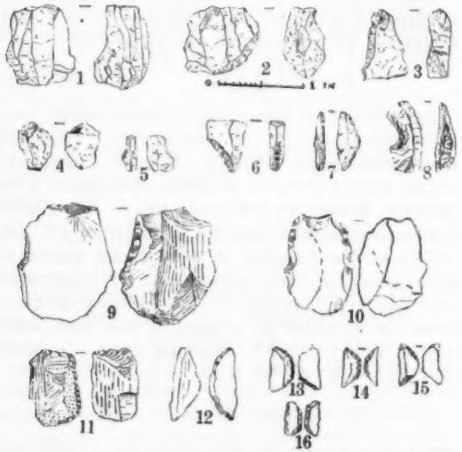


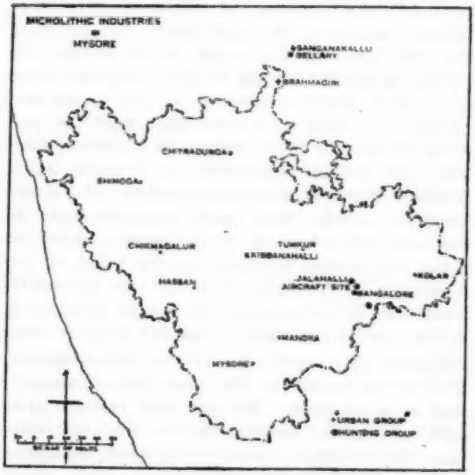
FIG. 1. *Microlithic artifacts from Kibbanahalli, Tumkur District, Mysore State:*

1-2. Fluted Cores. 3. Transverse arrowhead? 4-5. Microburins. 6. Tanged Blade. 7, 12, 14, 15 and 16. Lunates. 13. Trapeze. 8. Spokeshave. 9. Large flake used as side scraper. 10 and 11. Parts of exhausted cores retouched and used as side scrapers.

The Kibbanahalli microlithic industry, almost entirely of quartz, consists of cores which are mostly blade cores, though a few flake cores are present. Some of the large flakes have been slightly retouched and used as side scrapers (No. 9, Fig. 1). Other flakes which are small have also been used, a few possibly as transverse arrowheads (No. 3).

There is an interesting series of blades, some of which have been used as such; a few have been backed, and three have been transversely broken with retouched ends. Some of the blades are tanged also (No. 6).

In addition to the side scrapers already mentioned, there are a few specimens of hollow, double hollow and end scrapers.



But the most finished artifacts of the whole assemblage are the lunates (see Plate I). Of the five lunates, none has the chord trimmed. The sixth specimen may be regarded as a trapeze (No. 13). There is only one poor specimen of an obliquely retouched point.

Certain differences can be marked between the Jalahalli and Kibbanahalli industries. The

presence of the microburins may be regarded as a waste product and therefore is not significant. The absence of the burin in the Kibbanahalli industry should, however, be regarded as a differentiating feature and the Kibbanahalli industry is characterised by the rarity of asymmetrical backed points, but the assemblage is much too small to draw any significant conclusion.

Tentatively, therefore, the Kibbanahalli microlithic industry is distinguished into a third group, apart from Jalahalli and Brahmagiri I 'A' and 'B' industries respectively. Whether this new group can be separated from Brahmagiri Pre-I cannot be decided until more collections have been made at Brahmagiri.

PLATE 1. Lunates and asymmetrical points used as arrowbarbs (After Leakey).

It would appear, therefore, that four microlithic phases can be tentatively distinguished in Mysore State : (1) Jalahalli, (2) Brahmagiri Pre-I, (3) Kibbanahalli, and (4) Brahmagiri 'A' and 'B'. The argument for the distinction of (2) and (4) has been put forward elsewhere.[1] Typologically, the four phases are different, too, though the material from (2) is scanty.

There is no evidence for determining the age of the Kibbanahalli industry. All the finds come from the surface. Careful excavation of these spurs where the microliths were picked up could yield valuable information. At least, the association or non-association of pottery with these microlithic artifacts could be established. Typology is elusive and cannot help to elucidate the question of chronology. More intensive work on the site would be amply rewarded.

M. SESHADRI.

Maharaja's College,
Mysore, *July* 24, 1954.

1. *Microlithic Industries of Mysore : Annual Report of London University Inst. Arch.*, 1953.

AN UNREPORTED BAND OF INTERTRAPPEANS IN THE RAJAHMUNDRY AREA

DURING recent fieldwork in Rajahmundry area in the East Godavari District, exposures of calcareous bands consisting of marl and limestone were noticed underlain and overlain by Deccan traps.

Dr. M. S. Krishnan records about the Pangudi and Dudukuru area in the West Godavari District : "At least three flows of the trap can be made out, the lowest resting on the infra-trappean marls and containing in its upper part amygdaloidal cavities with agate and chalcedony. The junction between the lower and the middle flows is marked by a bed of limestone (Intertrappeans). The two upper flows are on hillocks where they are worked for road metal in a few places".[1] About the limestones of the Rajahmundry area he writes, "Intertrappean limestone occurs near Kateru, a couple of miles north of Rajahmundry under geological environments similar to those of Kovvur area".[2] Venkayya[3] also recognises only one intertrappean band in different quarries of the traps in the Kateru area.

A careful attempt was made during the present work to note the heights above mean sea-level of the occurrence of the exposures of the Intertrappean limestone bands in the different localities, their dip and their thickness. The interpolated disposition of the Intertrappean beds from the outcrops and bore hole data are indicated in Fig. 1.

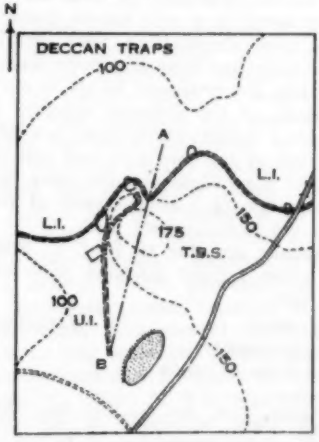


FIG. 1. Kateru Area. Scale : 1" = 3 Furlongs.
L.I.—Lower Intertrappean.
U.I.—Upper Intertrappean.

Fig. 2 is a section in the direction N.N.E.-S.S.W. across the T. B. S. Hill. The exposures of limestone at the top of the north-western portion of the T. B. S. Hill (No. 3), in the

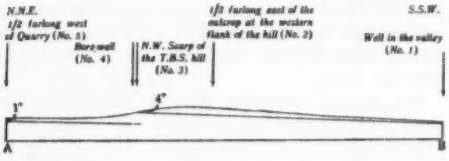

N.N.E.
1/2 furlong west of Quarry (No. 5)
Bore-well (No. 4)
N.W. Scarp of the T.B.S. hill (No. 3)
1/2 furlong east of the outcrop at the western flank of the hill (No. 2)
S.S.W.
Well in the valley (No. 1)
1°
4°
A
B

FIG. 2. Section along AB of Figure No. 1.

Scale $\left\{\begin{matrix}\text{Horizontal}\\ \text{Vertical}\end{matrix}\right\}$ 1″ = 1000 feet.

western flank of the hill (No. 2), and in the well about 2½ furlongs south (No. 1) appear to belong to the same band. The limestone band occurs at about 100′ in the well (No. 1), at 140′ at the western flank of the hill (No. 2) and at 160′ north-west of T. B. S. Hill (No. 3). These limestones have a southerly dip of about 4-5°. These are precisely the points where they would outcrop if they belong to the same band.

The study of the bore well log (No. 4) has brought to light the existence of a lower band of Intertrappeans. The bore hole just misses the upper limestone, penetrates through about 50′ of Deccan trap and comes on to a limestone band which is 3′ in thickness. This is again underlain by trap. The outcrop of limestone about 2 furlongs further north in a quarry (No. 5) is evidently a continuation of the band met within the bore hole. The band is 8′ thick in this quarry. Variation in thickness of Intertrappean bands is a well known feature.

These field observations very clearly indicate that there are three trap flows separated by *two distinct Intertrappean bands in the Kateru area*. Study of the different outcrops in relation to their heights above mean sea-levels, the log afforded by the bore hole, and opening up of a scarp of the hillock recently have facilitated the recognition of a second band of Intertrappean in the Rajahmundry area.

My thanks are due to Prof. C. Mahadevan under whose helpful guidance this work was carried out.

R. VAIDYANADHAN.

Geology Dept.,
Andhra University,
Waltair, *July* 27, 1954.

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2. —, *Ibid.*, 1950, **81** (2), 301.
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OCCURRENCE OF CALCIPHYRES NEAR MALLARAJANAHUNDI NANJANGUD (MYSORE STATE)

THE first reported occurrence of Calciphyres in Mysore State was near Nanjangud.[1] Recent geological work round about Nanjangud has revealed the occurrence of certain interesting limestone outcrops near Mallarajanahundi, about 8 miles N.-E. of Nanjangud.

The microscopic examination of a few representative slides of the limestones revealed a coarse granulitic texture with calcite, quartz, felspar, biotite mica, hornblende, augite, garnet, sphene and a lime-silicate mineral, spurrite. Spurrite occurs as colourless plates amidst the carbonate minerals and when the nicols are crossed, develops polysynthetic twinning. The twin lamellæ are bent and crumpled. It has high relief and a birefringence of 0·04, as determined by the Berek compensator. It is optically negative with $Y \wedge C = -33°$ and $2V = 40°$ as determined on the Federov's Universal Stage. A few grains of calcite develop biaxial character with $2V = 28°$ (as determined by the Mallard constant method) due to intense metamorphism which the rocks have undergone. Further work is in progress.

We are highly thankful to Dr. C. S. Pichamuthu for his encouragement and guidance in the work.

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Bangalore, *July* 5, 1954.

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L-GLUTAMIC ACID FROM AQUEOUS EXTRACTED CASTOR CAKE

AQUEOUS extracted castorcake has been found to be more suitable for the extraction of l-glutamic acid than commercially pressed castorcake. In aqueous extraction[1-3] where drying of the wet cake presents a problem, it was thought worthwhile to examine the possibility of isolating glutamic acid from the castorcake extracted by water, as this would be free of much of its water-soluble matter such as carbohydrate and inorganic matter which tend to retain[4] glutamic acid. A combination of Gilmans and Chibnall's[5,6] modified Ritthausen-Foreman methods for the isolation of glutamic acid has therefore been followed, using cake as the raw material rather than proteins.

Aqueous extracted castorcake (500 g. on dry cake basis) containing 20 per cent. moisture was hydrolysed for 18 hours with hydrochloric acid (1·375 litres) of sufficient strength to give a final concentration of 20 per cent., after making allowance for the water in the cake. The hydrolysate was concentrated and then filtered. The residue was washed thoroughly with concentrated hydrochloric acid. The filtrate along with washings was worked out for the recovery of glutamic acid.

The yields of glutamic acid from undefatted, defatted and aqueous extracted castorcake are recorded in Table I.

TABLE I

Nitrogen content %	% Total Nitrogen appearing in Glutamic acid	% Yield of Glutamic acid
(1) 3·2	8·0	2·7
(2) 4·6	7·4	3·6
(3) 4·3	8·4	3·9

(1) Undefatted cake; (2) Defatted cake; (3) Aqueous extracted castorcake.

It is evident from the data given in the above table that the yield of glutamic acid from aqueous extracted castorcake is higher than that obtained from defatted and undefatted cake samples.

The glutamic acid sample obtained as above from the aqueous extracted castorcake showed nitrogen content 10·8 per cent., m.p. 192·7° C. and $(\alpha)^{30}_{D}$= (+) 31·8 while that of the standard sample are 10·9 per cent., 199·0° C., (+) 31·5 respectively.

The authors' grateful thanks are due to Dr. R. C. Shah for helpful suggestions and criticisms.

National Chem. Lab. of India, Poona-8, *June* 27, 1954.

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J. P. VERMA.

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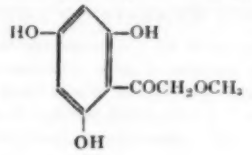
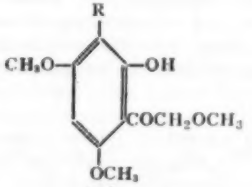
C-METHYLATION OF ω-METHOXY-PHLORACETOPHENONE

DURING the course of synthetic work in progress, a considerable quantity of C-methyl derivative of ω-methoxy-phloracetophenone (I) was required. This has been achieved by the nuclear methylation of ω-methoxy-phloracetophenone (I) using the method of Curd and Robertson.[1] 2-Hydroxy-ω : 4 : 6-trimethoxy-3-methylacetophenone (II, R = CH_3) is a colourless crystalline solid and gives a prominent colour with alcoholic ferric chloride and a blue colour with 2 : 6-dibromoquinonechlorimide, the latter reaction indicating that the position para to the free hydroxyl is unsubstituted. The corresponding O-dimethyl ether (II, R = H) is also obtained in small quantity as a by-product.



(I)



(II)

(R = CH_3 or H)

ω-Methoxy-phloracetophenone (2 g.) was gently boiled under reflux with methyl iodide (8 ml.) and anhydrous potassium carbonate (14 g.) in acetone solution (50 ml.) for about 3 hours. The potassium salts were removed by filtration and slow evaporation of the acetone solvent deposited slightly reddish-brown square pyramids and rectangular plates. Purification was carried out by dissolution in ether and washing with water wherein the coloured impurities were insoluble. Removal of the solvent left a residue which appeared as colourless long rectangular plates tapering at the ends. Crystallisation from methyl alcohol gave the product as long colourless needles slightly bulging at the centre, m.p. 141-42° C. Yield : 0·5 g. (Found : C, 55·9; H, 7·2; loss on drying at 110° C. for 2 hours in high vacuo, 6·9; $C_{12}H_{16}O_5$, H_2O requires C, 55·8; H, 7·0 and loss on drying 7·0 per cent. Found in sample dried at 110°, C, 60·3; H, 6·9; $-OCH_3$, 39·0;

$C_{12}H_{16}O_5$ requires C, 60·0; H, 6·7 and $-OCH_3$, 38·8 per cent.). The dried substance melted at 176-77°. The alcoholic mother liquor on dilution with water precipitated a crystalline substance which was identified as 2-hydroxy-ω : 4 : 6-trimethoxy-acetophenone, m.p. 104-05° C. A mixed melting point with an authentic sample of 2-hydroxy-ω : 4 : 6-trimethoxy-acetophenone was undepressed.

The author desires to thank Prof. T. R. Seshadri for his interest in the work.

Dept. of Chemistry, V. VENKATESWARLU.
Andhra University,
Waltair, *July* 20, 1954.

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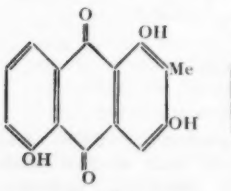
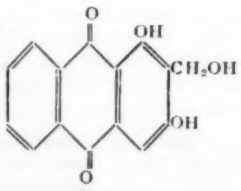
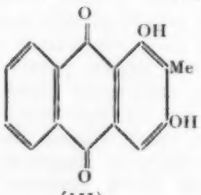
A SYNTHESIS OF LUCIDIN

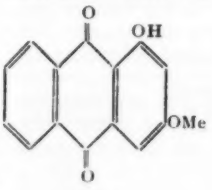
FROM the bark of *Coprosma lucida* Briggs and Nicholls[1] isolated a new anthraquinone colouring matter, lucidin, to which they ascribed the structure 1 : 3 : 5-trihydroxy-2-methylanthraquinone (I). Reconsideration of some of the properties and the infrared spectrum of lucidin led them subsequently to revise the constitution to 1 : 3-dihydroxy-2-hydroxymethylanthraquinone (II).[2] We have confirmed the latter structure (II) by an unambiguous synthesis.

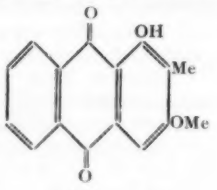

(I)

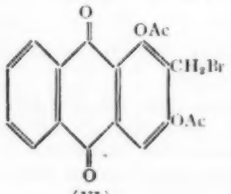

(II)


(III)

Rubiadin, 1 : 3-dihydroxy-2-methylanthraquinone (III), has been synthesised earlier by several methods, but all are tedious and give poor yields.[3] A greatly improved procedure is an application of the method of Marschalk *et al.*[4] for C-methylation in the anthraquinone series; thus the treatment of the leuco derivative of xanthopurpurin 3-methyl ether (IV) with formaldehyde gave rubiadin 3-methyl ether (V), which was demethylated to rubiadin (III) by means of boiling hydrobromic and glacial acetic acids. A convenient route to (IV) was the deamination of 1-amino-2 : 4-dibromoanthraquinone, replacement of bromine by methoxyl by refluxing with sodium methoxide in methanol, and partial demethylation of the resultant 1 : 3-dimethoxyanthraquinone with hydrobromic acid and acetic acid. Treatment of rubiadin diacetate with N-bromosuccinimide in boiling carbon tetrachloride gave the ω-bromo derivative (VI); the position of the bromine


(IV)


(V)


(VI)

atom was indicated by the ready formation of a pyridinium salt. When (VI) was treated with sodium acetate in boiling alcohol, hydrolysis of both the bromine atom and acetyl groups took place, the product being (II), identical in all its properties with natural lucidin. The triacetate of (II), lucidin triacetate and a mixture of the two had the same melting point, 175-76°.

We are greatly indebted to Dr. L. H. Briggs for samples of natural lucidin and its triacetate.

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Univ. of Bombay, N. PARKASH.
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Bombay-19, *August* 14, 1954.

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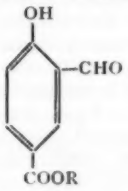
4-HYDROXY-3-ALDEHYDO BENZOIC ACID

DUFF AND BILLS[1] could not isolate any product by the action of hexamine on *p*-hydroxy benzoic acid. Recently Seshadri and Thiruvengadam[2] prepared 5-aldehyde of vanillic acid by this method. Hence the action of hexamine on *p*-hydroxy benzoic acid and its ethyl ester has now been reinvestigated. They yield the 3-aldehydes (I) in 30 per cent. yield. The position of the aldehyde group is established by oxidation with alkaline hydrogen peroxide to protocatechuic acid in 80 per cent. yield.



I

a, R = H

b, R = C_2H_5

4-Hydroxy-3-aldehydo benzoic acid (I a)

p-Hydroxy benzoic acid (3 g.) and hexamine (12 g.) were dissolved in glacial acetic acid (20 ml.) and heated on a boiling water-bath for six hours. Boiling hydrochloric acid (1 : 1, 30 c.c.) was then added and the heating continued for half-an-hour. The solution was diluted with water and left in refrigerator for 3-4 days. The aldehyde that separated out crystallised from dilute alcohol as pale yellow small prisms, m.p. 232-34°; yield 1 g. (Found: C, 58·1; H, 3·7; $C_8H_6O_4$ requires C, 57·8; H, 3·6 per cent.)

Ethyl-4-hydroxy-3 aldehydo benzoate (I b) was prepared in the same way by the action of hexamine (12 g.) on ethyl-*p*-hydroxy benzoate (3 g.) in glacial acetic acid medium (20 ml.). It crystallised from hot water containing a few drops of alcohol as pale yellow long needles, m.p. 104-06°. Yield (1·1 g.) (Found: C, 62·1; H, 5·2; $C_{10}H_{10}O_4$ requires C, 61·8; H, 5·1 per cent.) It gave a deep brown colour with ferric chloride and showed a sky-blue fluorescence in sodium carbonate solution. The 2, 4-dinitrophenyl hydrazone crystallised from glacial acetic acid and melted at 272-73°.

The ester, when hydrolysed by heating with dilute sodium hydroxide solution gave I *a*; m.p. 232-34° undepressed by sample obtained as above.

Protocatechuic acid (II)

4-Hydroxy benzoic acid-3-aldehyde (1 g.) was dissolved in sodium hydroxide (N. 10 ml.) and to the cooled yellow solution (10-15°), hydrogen peroxide (6 c.c., 6 per cent.) was added dropwise during the course of half-an-hour. It was then allowed to stand at room temperature for 3 hours with occasional shaking, acidified with dilute hydrochloric acid and the product crystallised from hot water, yield 0·8 g., m.p. 194° undepressed by an authentic specimen of protocatechuic acid.

Our thanks are due to Prof. T. R. Seshadri for his kind interest in this work, and to Dr. S. K. Mukerjee for microanalysis.

Chemistry Dept., V. K. AHLUWALIA.
Delhi University, V. V. S. MURTI.
Delhi-8, *June* 2, 1954.

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THE ANATOMY AND MODE OF ACTION OF THE HEART OF FROG *RANA TIGRINA* DAUD.

THE frog has formed the subject of a series of investigations since the beginning of modern Zoology. The European species *Rana esculanta* (Gaupp[1]) and *Rana temporaria* and the American species *Rana pipiens* (Holmes[2]) have been carefully investigated. The Indian species have not been properly worked out.

In the present study, the heart of *Rana tigrina* Daud. has been selected for detailed investigation. It is a type prescribed for study in the majority of the Indian and Pakistan Universities and also in other neighbouring countries. The study is likely to throw light on the age-old controversy about the distribution and circulation of blood in the heart and the *Truncus arteriosus*.

Some new facts noted are: (1) the arterial type of structure of pulmonary veins, (2) the presence of a new chamber, the *Recessus pulmonalis* (Sharma[3]), (3) the presence of valves between the anterior venae cavae and the *Sinus venosus*, (4) the extension of the *Septum atriorum* beyond the atrio-ventricular cavity into the ventricle and its attachment to valves, (5) the origin of the *Truncus arteriosus* from the *right dorsal* surface of the ventricle, (6) the division of the ventricular cavity into *five* spaces, (7) the origin and disposition of the valves, *four* and not three in number, at the opening of the ventricle into the pylangium, (8) the origin, disposition, and hinge-like attachment of the *spiral valve*, with its double hammer-headed top heavy head which adpresses

the pad-like valve mentioned for the first time, (9) the extension of the spiral valve at its distal end into *two* cup-shaped valves instead of one, (10) the guarding of the systemo-carotid and the pulmo-cutaneous passages each by a pair of valves; thus the synangium containing four and not three valves, (11) the joint origin of the systemo-carotid arches, and (12) extension of the synangium into a short but distinct region, the *geminangium*, and the disposition of the arches.

The 'classical hypothesis' and the 'complete mixture' theory do not hold good on the basis of the above anatomical facts and the conclusion drawn is, that the systemic and the carotid arches receive the same stream from the left auricle, and if at all, there is some mixture, it is small, and this is so, perhaps when the right stream is followed by the left, which takes a longer route through the central cavity.

Further work is in progress and a detailed study will be published elsewhere soon.

Birla College of Science, H. L. SHARMA.
Pilani, *August* 7, 1954.

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CONSTITUTION OF CORCHORIN, A BITTER PRINCIPLE OF JUTE SEEDS

TSUNO[1] first reported the occurrence of a bitter principle, corchorin, in jute seeds (*Corchorus capsularis*, L.) but it was Sen[2] who isolated it from the alcoholic extract of the seeds in white prisms, m.p. 174-75° C., having an intense bitter taste and properties characteristic of the digitalis group of saponins.[3] According to him, corchorin has the molecular formula, $C_{22}H_{36}O_8$ and when hydrolysed with acid, yields glucose and corchogenin, $C_{16}H_{26}O_3$, m.p. 112-14° C. Soliman and Saleh[4] also isolated corchorin from jute seeds as rhombic prisms, m.p. 175-77° C. (dec.) but they were unable to hydrolyse corchorin with 2 per cent. sulphuric acid or with "varying concentration of hydrogen chloride in dilute alcohol". They assigned to it the formula, $C_{23}H_{32}O_6$ with 0·5 H_2O as water of crystallisation and showed it to be identical with strophanthidin.

For this investigation, corchorin was obtained by a simplified method. Finely powdered jute seeds in batches of 500 g. were extracted with rectified spirit (95 per cent. ethanol). Alcohol was then completely removed under reduced pressure, and the residue digested with boiling water and filtered. From the filtrate corchorin was isolated following Sen's lead acetate method, and crystallised from methyl alcohol as prisms, m.p. 177-78° C. (dec.). Corchorin, thus obtained, contained no water of crystallisation. When hydrolysed with acid, it yielded a mole of glucose (estimated by Benedict's method) and corchogenin, $C_{17}H_{22}O_3$. [Found: C, 73·9; H, 8·1; Mol. wet. (cryoscopic, acetic acid) 276·4 and (Rast) 273·1. $C_{17}H_{22}O_3$ requires C, 74·5; H, 8·0 per cent., Mol. wt. 274.] In view of the conflicting observations mentioned above, as regards hydrolysis of corchorin, experiments were carried out independently by two of us (A. A. and A. K.) with corchorin isolated from various samples of jute seeds (both *C. capsularis* and *C. olitorius*). The procedure adopted for hydrolysis was as follows:

To corchorin (1·2 g.), dissolved in about 50 ml. absolute alcohol, was added 2 ml. sulphuric acid (S.G. 1·836) and heated over steam-bath for four hours with reflux condenser. The resulting mixture was then concentrated to about 15 ml. and left overnight after diluting with 10 ml. water, when yellow amorphous corchogenin separated out. After treatment of its alcoholic solution with activated charcoal, corchogenin was finally crystallised from a mixture of ether and ethanol as prisms, which shrank at 84-85° C. and melted at 115-16° C. To the acid solution, left after separation of corchogenin, was added an excess of barium carbonate, the mixture boiled for a few minutes and filtered. The filtrate was extracted several times with chloroform to remove trace of corchogenin. When the filtrate was concentrated, there remained a syrupy liquid, which was converted into osazone, m.p. 204-05° C., benzoate, m.p. 179-80° C. and benzimidazole, m.p. 212-14° C. (dec.). The melting points of these derivatives were undepressed by admixture with authentic specimens prepared from D-glucose.

In the light of these experiments, we find it difficult to accept the view that corchorin does not contain a sugar moiety and that it is identical with strophanthidin.

Org. Res. Lab., ASHRAFUL ALAM.
Dept. of Chemistry, ABDUL KHALIQUE.
Dacca University, MOFIZUDDIN AHMED.
Pakistan,
April 7, 1954.

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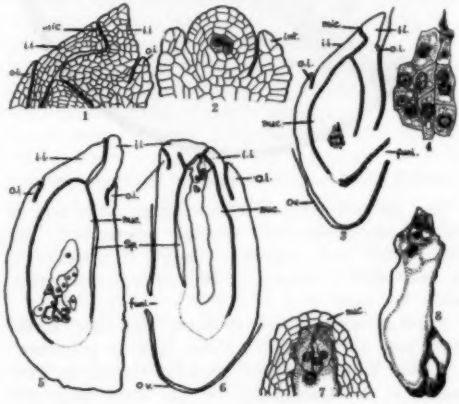
GAMETOPHYTES IN *BALSAMODENDRON* MUKUL. HOOK.

PRACTICALLY the only embryological work done on Burseraceæ is by Wiger,[3] which was adversely criticised by Mauritzon.[2] Wiger studied five genera, the genus *Commiphora* (= *Balsamodendron*) being also included; the account presented, however, is very meagre.

Before maturation, the microspore mother cells were found to degenerate. The ovary is embedded in the concavity of the erect and cupular disc.

The young ovules originate as hood-like protuberances in which one sometimes many hypodermal archesporial cells develop and before functioning as megaspore mother cells, cut primary parietal cells on the outside which undergo repeated divisions (Fig. 2). At a later stage therefore, the megaspore mother cell or cells are found to lie rather very deep in the nucellus. The nucellus thus, is mostly parietal in origin. The nucellar epidermis also shows divisions and contributes to the nucellus (Fig. 2).



mic., micropyle; *o.i.*, outer integument; *i.i.*, inner integument; *nuc.*, nucellus; *funi.*, funiculus; *OV.*, ovary wall. Sp., Space.

FIG. 1. Upper portion of the ovule showing integuments, S-shaped endostome.

FIG. 2. Two sporogenous cells: note the parietal tissue, divisions in the nucellar epidermis and the single integument.

FIG. 3. Young ovule showing 3 degenerating megaspores just above the young binucleate embryo sac, the rest appear to be embryo sac mother cells.

FIG. 4. Same magnified.

FIG. 5. Ovule showing a number of one and two-nucleate embryo sacs; a two-nucleate embryo sac enlarging.

FIG. 6. Mature ovule, the synergids have digested the nucellus, are lying at the base of the micropyle in contact with the inner integument.

FIG. 7. Upper portion of the nucellus showing the egg-apparatus and the secondary nucleus. The synergids active in corroding the nucellus.

FIG. 8. Mature polygonum type of embryo sac: note two degenerating embryo sacs at the foot.

There is only one integument in the beginning (Fig. 2) but the outer integument originates soon afterwards. Wiger observed only one integument. The inner integument grows faster and forms an endostome which is S-shaped (Fig. 1), the apex of which protrudes into the style. The outer integument does not take part in the formation of the micropyle. The inner integument and the nucellus are free (Figs. 5, 6).

The megaspore mother cell undergoes usual meiotic divisions to form a linear tetrad of megaspores. Occasionally there are many tetrads in the same nucellus and quite commonly more than one embryo sac mother cell begin to develop simultaneously giving rise to a number of uni-, bi- (Figs. 3, 4, 5) and tetranucleate embryo sacs. In such cases, however, usually only one embryo sac survives. Fig. 8 show two degenerating embryo sacs at the foot of the mature embryo sac.

The mature embryo sac conforms to the general organization seen in 8-nucleate embryo sacs (Fig. 8), Maheshwari.[1] The embryo sac corrodes the nucellus in almost all directions. Antipodals are ephemeral. The synergids frequently show frothy protoplasm (Figs. 6, 7). In Fig. 6 the synergids have also approached upwards reaching at the base of the micropyle.

I am indebted to Prof. B. Tiagi for guidance and to Principal V. V. John and Dr. I. M. Rao of Agra College, for encouragement and assistance.

Dept. of Botany, R. D. SHUKLA.
Govt. College, Ajmer,
July 8, 1954.

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A NEW BOTHRIOCEPHALID PARASITE (CESTODA) FROM THE GUT OF THE FISH *SAURIDA TUMBIL* (BLOCH)

IN the course of his studies on helminth parasites from food fishes of Waltair coast, the author found that the common fish *Saurida tumbil* (Bloch) harboured adult cestodes. While cestodes in marine fishes of India have been investigated by various workers,[2,4-7] the only previous record of the occurrence of an adult cestode in a marine teleost is that of

Shipley's account[4] of *Bothriocephalus histiophorus* from the Sword-fish *Histiophorus* sp. Woodland[9] described *Bothriocephalus pycnomerus* from the fresh-water fish *Ophiocephalus marulius* at Allahabad. Ganapati and Rao[1] recorded a third species, *Bothriocephalus indicus* n. sp., from *Saurida tumbil* (Bloch).

The present form also from the same host *Saurida tumbil* (Bloch) is a gut parasite. While the environment of the strobilar phase of all tapeworms excepting *Stilesia* and *Thysanosoma* is the small intestine of vertebrates (Wardle and McLeod[8]), the present parasite is peculiar in that its scolex is embedded in liver while its strobila lies free in the lumen of the intestine. In *Stilesia* and *Thysanosoma* the entire worm lies in the bile duct. The liver cells around the scolex of the present form become necrotic and finally get replaced by fibrous tissue (Fig. 1). An adventitious cyst

FIG. 1. Section of liver showing necrotic cells (*n*) and fibrous tissue (*f*) around the scolex.

wall is thus developed which envelops the scolex. In some cases the scolex may even undergo degeneration and what remains is a coiled mass lodged in a cyst (Fig. 2) buried in the liver.

While it is possible for the worms, owing to the extreme slenderness of the anterior region of the strobila, to get into the liver through the bile duct, it is curious that they prefer to enter the body cavity piercing the intestinal wall and reach the liver. In the young infected fish, parasites with free scolices have been observed in the body cavity, just below the liver, as well as forms where the scolices have just invaded the liver.

It is obvious that in the infected fish the parasites in addition to causing mechanical obstruction to the free passage of food through the intestine, also damage the liver by their penetration and attachment to the latter organ.

FIG. 2. Coiled anterior region of the parasite in cyst.

The present form does not agree with any of the Bothriocephalid species described by Yamaguti[10] and Linton.[3] Hence it appears to be new and is named as *Bothriocephalus ganapattii* sp. nov.

Further work on this form and the histopathology of the host's tissue are in progress.

I wish to express my grateful thanks to Professor P. N. Ganapati, for his kind help and encouragement.

Dept. of Zoology, K. HANUMANTHA RAO.
Andhra University, Waltair,
June 10, 1954.

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A RECORD OF MALLOPHAGAN PHORESY BY *PSEUDOLYNCHIA MAURA* (DIPTERA, HIPPOBOSCIDAE)

THERE are records of Mallophaga having been carried from one host to another through the agency of Hippoboscid flies. Lense[1] coined the word 'phoresie' for this act of mere mechanical transference of one insect on the body of another larger one, without its feeding on the latter. Since then, this term has been adopted by several workers in the form of 'phoresy'.

Clay and Meinertzhagen[2] were the first to summarize all the published records of Mallophagan phoresy by Hippoboscid flies. They observe that the act takes place on the bird-host and the Mallophaga concerned belong to the genera *Philopterus* and *Brüelia*. Subsequently, Hopkins[3] made an interesting record indicating that the members of *Amblycera* are similarly implicated in cases of phoresy and the louse concerned is *Menacanthus gigenteus* (Denny). Ansari,[4] during his study on Mallophaga from birds of the Punjab, came across two examples of phoresy between a Mallophaga and Hippoboscidæ, and stated that the transport of Mallophaga by the bird-flies is purely accidental and not a common feature. From the available records, it is ascertained that the Hippoboscide concerned are species of *Ornithomyia*, *Ornithoica* and *Lynchia*. The locations most favoured by the louse are usually the wings, legs or abdomen; the attachment is by the mandibles around the roots of hairs or veins of wings but not by embedding themselves into the abdominal wall of the fly.

Recently we came across a case of phoresy, which appears to be the second of its kind from India. The Hippoboscid was found on the wall of a house in Bombay, during the early hours of 12th February 1954. On examination it turned out to be *Pseudolynchia maura*, a hippoboscid, commonly found on pigeons (*Columba livia*), kites (*Milvus migrans govinda*) and crows (*Corvus* sp.), in this part of the country. At the same time, it was interesting to notice a Mallophaga, one of the Ischnocera, firmly attached to the right side of the abdomen of the fly by means of mandibles and legs. As it was desired to preserve the specimens intact, it was not possible to ascertain whether the mandibles were embedded in the abdominal wall or simply attached to the roots of hairs. For the same reason, the specific identity of the louse could not be determined.

The detection of Hippoboscid away from the body of the host throws further light on the evidences of the possible transmission of lice from host to host through the agency of flies. The specimens were sent to Miss Theresa Clay of British Museum, who identified the louse, a female, as a species of *Brüelia*, belonging to the group found on the members of the Corvidæ, probably *Corvus* species. This record is of importance as it reveals another case of *Brüelia* being involved in phoresy, and also that the host is parasitic on Corvidæ, if this is not already known.

Bombay Veterinary College, L. S. HIREGAUDAR.
Bombay, *June* 27, 1954. F. S. KHAMBATA.

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INCIDENCE OF INFERTILITY UNDER VARIOUS CAUSAL GROUPS IN BUFFALO COWS IN INDIA

THE buffalo holds an important position in the dairy industry of this country. It is therefore a matter of surprise that this useful animal has received such scanty attention from workers in the field of physiology and pathology of reproduction, especially since disorders of reproductive functions effect the productivity of the animal so adversely. No information regarding the causes of infertility and its incidence under various causal groups in buffaloes is available excepting a few cases mentioned by Polding and Lall.[1] Studies in this direction have been taken up at this Institute in recent years. As a part of these investigations, examination of the genital organs from the female buffaloes destroyed at the Bareilly abattoir was made. Personal enquiries made from the owners of these animals revealed that the animals found their way to the slaughter house as they were considered to be infertile.

Out of 1020 genital organs examined, 100 (9·8 per cent.) were from heifers. Out of 920 specimens of genitalia from adult buffalo cows, 150 (16·3 per cent.) were found to be in gravid condition. The stage of pregnancy in majority of cases (90 per cent.) varied between 4-14 weeks. It may be mentioned here that at this early stage it would be difficult for laymen to know that the animals are in pregnancy. The incidence of defects and disorders of various types found in 770 adult buffalo cows and 100 buffalo heifers are given in Table I. Total ovarian hypoplasia has been reported in foreign

TABLE I

Types and sites of disorder	Buffalo cows		Buffalo heifers	
	Unilateral %	Bilateral %	Unilateral %	Bilateral %
OVARIAN BURSA				
1 Adhesions	4·16	10·91	3·00	11·00
2 Hydropsii bursa	0·52	0·13	..	..
3 Lymphoids	..	3·90	..	..
MESOSALPINX				
1 Cysts	2·38	0·39	2·00	1·00
FALLOPIAN TUBES				
1 Salpingitis	0·78	0·13	..	..
2 Hydrosalpinx	1·04	0·65	2·00	1·00
3 Pyosalpinx	..	0·13	..	..
4 Blind fallopian tube	0·13	..	1·00	..
OVARIES				
1 Oöphoritis	6·10	2·21	3·00	4·00
2 Encapsulation	2·34	0·78	..	3·00
3 Fibrosis	4·16	0·78	5·00	1·00
4 Dermoids	0·78	0·13	..	..
5 Subactive condition	2·73	5·97	2·00	6·00
6 Hæmatoma	1·43	..	..	..
7 Luteinised follicles	0·52	..	..	..
8 Cysts	3·77	0·65	..	..
9 Persistent corpus luteum	2·08	..	..	..
UTERUS				
1 Metritis	27·15		11·00	
2 Parametritis	4·72		..	
3 Internal adhesions	0·13		..	
4 Hydrometra	1·56		5·00	
5 Pyometra	0·52		4·00	
6 External cysts	1·69		..	
7 Lymphoids	4·68		1·00	
8 Atonicity	3·12		4·00	
CERVIX				
1 Cervicitis	10·52		1·00	
2 Adhesions	0·26		1·00	
3 Cysts	0·39		..	
VAGINA				
1 Vaginitis	11·69		5·00	
2 Occlusion in vagina	0·39		1·00	
Disturbed endocrine balance*	6·10		6·00	

* As judged from the abnormal condition of Graffian follicles and corpus luteum.

literature, but no such case has been detected in the specimens examined by us. The incidence of metritis and cervicitis is quite high in adult animals. It is intended to publish the results of the entire investigation in detail elsewhere.

Animal Genetics Division, P. BHATTACHARYA.
Indian Vet. Res. Inst., S. N. LUKTUKE.
Izatnagar, U.P., India, A. S. P. RAO.
June 12, 1954. S. K. DE.

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POST-EMBRYONIC DEVELOPMENT OF TESTES IN SUBFAMILIES GALERUCINAE AND ALTICINAE OF THE FAMILY CHRYSOMELIDAE (COLEOPTERA)

THE testes adopts a mesial position in the form of median organ joined posteriorly with lateral ejaculatory ducts through a pair of vasa deferentia in the subfamilies Galerucinæ and Alticinæ of the family Chrysomelidæ (Fig. 1). While studying the post-embryonic development of the male reproductive organs in *Galerucella birmanica* Jac. the author observed that, in the larval (Fig. 2) and pupal (Fig. 3) stages, the testes maintain their paired existence, each connected with separate vas deferens like other species of Coleoptera including the remaining subfamilies of Chrysomelidæ but as the maturity of pupa advances the two testes drift mesially, uniting ultimately before the emergence of imago to form a median testis which is distinctly lobed. The reason for these two coalescence is still a mystery in these two subfamilies which are phylogenetically interrelated, and is being worked out.

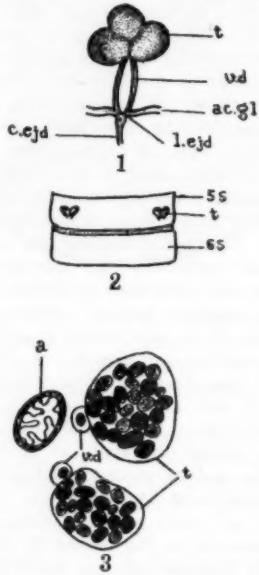

FIG. 1. Male reproductive organ of *G. birmanica*, × 11.
FIG. 2. Larval segments showing testes, × 10.
FIG. 3. Transverse section of pupa showing testes, × 54.
a—alimentary canal; *ac. gl.*–accessory gland; *c.ejd.*–common ejaculatory duct; *l. ejd.*–lateral ejaculatory duct; *s.*–sternite; *t.*–testes; *v.d.*–vas deferens.

Section of the Entomologist to Govt., Uttar Pradesh, Kanpur, *June* 22, 1954. B. K. VARMA.

REVIEWS

The Origin of the Earth. By W. M. Smart. (Cambridge University Press), 1953. Pp. vi + 239. Price 18 *sh.*

Professor W. M. Smart is a distinguished scientist, who has to his credit many advanced books on astronomy and astrophysics. It is not surprising therefore that in his attempt to deal with the origin of the earth, he has presented a very popular and lucid and at the same time authoritative account of the latest advances not only in astronomy but in the physical and geological sciences as well.

Dividing the subject into three parts, "whence", "when" and "how", the author has examined the various theories in the past and those made in recent years and has, with a good deal of caution, come to the following tentative conclusions. There is good evidence, the author says, to assert that the earth and the whole solar system is derived from a single activity on a great scale in the distant past, though there is still some doubt whether this activity was in the sun or in some unknown star—which would then be the parent of the whole solar system. Also, the age of the solar system and that of the earth can be placed to lie between 3,000 and 4,000 million years. The author has, however, left the last query as to how the earth came into being as a problem still awaiting a correct solution, since all the theories proposed up to date fail to carry conviction.

The book is quite readable and very popular in its treatment of advanced topics in astronomy. It can be read with great profit by non-astronomers as well.

On the Congruence of Sets and Their Equivalence by Finite Decomposition. By Waclaw Sierpinski. (Lucknow Univ. Studies, No. XX), 1954. Pp. 117. Price not given.

This study by Professor Sierpinski gives a very readable and interesting account of congruence of sets and equivalence by finite decomposition, mainly for sets in Euclidean spaces of 1, 2 or 3 dimensions. Congruence is defined as an isometry between subsets of a metric space. Any two subsets A, B which can be partitioned into the same finite number (n) of mutually disjoint subsets $A = \Sigma A_i$ $B = \Sigma B_i$ so that A_i and B_i are congruent for each i, are said to be equivalent under finite decomposition (into n parts). Typical results are :

There is a linear set (*i.e.*, subset of the Euclidean line) and an enumerable family of mutually disjoint linear sets such that any linear set superposable by translation with E belongs to the family ; and the linear set cannot be Lebesgue measurable. The straight line is equivalent by decomposition into two parts to the set obtained by retraction of any enumerable set from the line. A rectangular isosceles triangle is equivalent to a square by finite decomposition. There exists a plane set which is the sum of two disjoint sets each congruent to the square. But a linear set cannot have such a paradoxical resolution (into disjoint subsets equivalent to the whole by finite decomposition). A segment of a straight line is not equivalent by finite decomposition to any smaller segment. A solid sphere is equivalent under finite decomposition to two disjoint spheres of the same radius. Any two bounded sets in three dimensional space are equivalent by finite decomposition if each of them contains a solid sphere. Any circle S is smaller by finite decomposition than any circle S', *i.e.*, S and S' can be partitioned into the same finite number (n) of disjoint subsets $S = \Sigma A_i$ and $S' = \Sigma B_i$ such that for each i there is a biunivocal mapping of A_i in B_i which diminishes distances.

V. S. KRISHNAN.

A Treatise on Applied Hydraulics. Fourth Edition. Revised and Enlarged. By Prof. Herbert Addison. (Chapman & Hall), 1954. Pp. vii + 724. Price 56 *sh.*

Students of hydraulics need no introduction to Addison's classical work on Applied Hydraulics. It is well known that every development in fluid mechanics that takes place in the numerous richly endowed aerodynamic laboratories either adds directly to our knowledge of hydraulics or opens out a new field of investigation. As the volume was published twenty years ago a revised edition embodying the latest developments in the field is a welcome addition to the literature on the subject.

In the present edition, the original style of presentation has been maintained. Considerable

matter that is new has been added. More information on hydrodynamics, particularly in regard to the properties of irrotational motion and conformal mapping, are necessary to understand the recent developments in the design of propellers and runners. While discussing turbulence Von Karmen's theory may have also been included. It is hoped that these will be added in the next edition of this standard work on applied hydraulics.

N. S. GOVINDA RAO.

Rocket Propulsion. Second Edition. Revised. By Eric Burgess. (Chapman & Hall, Ltd.), 1954. Pp. 228. Price 21 *sh.*

The book introduces the reader to the subject of rocket propulsion, setting out the basic principles of rocket dynamics—jet flow, thrust, specific consumption of a rocket motor, propulsive efficiency, mass ratio, etc. After an interesting account of solid and liquid fuels with their compositions useful for signal rockets and fireworks, military projectiles, fluid missiles, etc., the characteristic properties necessary for an ideal rocket propellant are deduced. The engineering details of the combustion chamber, the rocket nozzle for an ideal velocity and various methods of fuel cooling in regenerative systems for increasing the thermal efficiency of the motor are very elegantly described. The author is of the opinion that no existing basic motor design theory is suitable for a rocket motor, and it is only trial and error in future research that must establish a fundamental rocket motor theory. Problems of fuel feed and fuel tanks for various types of rocket motor with illustrations are given. The chapters on control of flight, long range rocket projectiles, the rocket and the interplanetary travel and the use of atomic energy for rocket propulsion to the moon are presented in a fascinating way not only for the layman but also to engineers, physicists, chemists, etc.

Though there is no fundamental difference in structure between the old and revised editions, yet the author has endeavoured to bring the latter up to date by additional details here and there. A section on expendable construction, its effective mass ratio and data on the possible use of instrumented probes for deep space research is given in the revised edition.

All those who might lay their hand on this book will read it with absorbing interest, for, who would not be interested in the story of man's age-old dream of journey to the moon—especially when it is told in such an admirably simple style as the author has done?

M. SANTHAPPA.

The Chemistry of Heterocyclic Compounds. Edited by A. Weissberger. **Compounds with Condensed Thiophene Rings.** By H. D. Hartough and S. L. Meisel. (Interscience Publishers), 1954. Price $ 16.50.

The literature on condensed systems containing a thiophene ring is so voluminous that a volume separate from *Thiophene and Its Derivatives* has had to be devoted to it. As in earlier volumes of the series compounds of each type are listed in tables, together with their physical constants, reaction conditions, yields and other data. The original draft of the book was completed in May 1951, but some references up to May 1952 have been included. Chapter I deals with factors influencing chemical reactivity and substitution of thiophene systems, and Chapter II with thianaphthene and other thiophene compounds containing one carbocyclic fused ring. Chapter III on thioindigo and related dyes is the least satisfactory part of the book. The chapter begins with the amazing statement: "The isosteric relationship between indigo and thioindigo dyes was responsible for the rapidity with which the thioindigo dyes reached commercial importance.." Information from Colour Index (1924) is reproduced, and valuable space is wasted by presenting the umbrella and tower formulæ for indigo before proceeding to the accepted structure. It is claimed that the discussions in this chapter are from "an academic viewpoint", but it is difficult to see why such a viewpoint should exclude technically important dyes and their syntheses, or why it should include a list of patents on thioindigoid dyes running into ten pages. The term "dye composition" is used erroneously for dyes. In the reference to nitrobenzene (p. 186) it is forgotten that this solvent is also an oxidizing agent. There is a useful summary of the work of S. K. Guha, P. C. Dutta and others on empirical relationships between colour and constitution in the thioindigoid series.

Chapters IV and V describe dibenzothiophene, naphthothiophenes, and their derivatives. Chapters VI, VII and VIII, dealing with thiophene systems containing three or more carbocyclic fused rings and with condensed thiophones containing O, S, Hg and N ring systems, are particularly interesting and suggest many problems for research.

The book as a whole is somewhat disappointing. It will be useful for reference, but parts of the book are difficult to read and give the impression of being merely an elaboration of the Ring Index.

Several errors have been noticed and examples are the formula for isothianaphthene (p. 167); quindoline is not the "pyridine isostere" of compound (I) in p. 435; the resonance indicated in p. 318 is contrary to substitution reactions (*e.g.*, bromination) of dibenzothiophene; the structure assigned by Eistert (*Ber.*, 1947, 80, 47) to the condensation product of 3-hydroxythianaphthene and 2 : 3-dichloro-1 : 4-naphthoquinone has not been mentioned; the compound, m.p. 209°, mentioned in p. 386 has been shown by Baker (*J. C. S.*, 1952, 3163) to be dibenzothiophthene; in p. 387, line 2, "1, 5-bis" should read as "2, 6-bis"; the paragraph in p. 374 commencing with "The structure of I" needs to be rewritten.

K. V.

Spot Tests, Part II. (*Organic Applications.*) By Fritz Feigl. (Elsevier Publishing Co., Ltd.), 1954. Pp. xv + 436. Price 37 *sh.* 6 *d.*

The volume under review is an inspiring record of years of careful work by the author. An excellent case has here been made for the use of spot tests as an elegant method in the identification of intermediates and final products.

The seven chapters comprising the book lead the reader through all the stages of a thorough study of the subject. The chapter on equipment and techniques is contributed by Dr. Ph. W. West whose contributions in the field of microchemistry are well known. It would be highly profitable for students and instructors alike to master the two chapters (pages 50 to 232) and to remember that the correct identification of a functional group, corresponding to testing for cationic and anionic constituents in inorganic analysis, can be achieved only by a careful process of direct and indirect tests. Full instructions are given, following which one should be able to do the work quickly and correctly. Chapter 5 deals with the characteristics of 51 individual substances. Any instructor, who is able to take his class through these compounds, can be sure that he has imparted the best training.

The chapter on applications of spot reactions for technical and scientific purposes is more in the form of an introduction than a full course treatment. It opens out the way for interested persons to employ spot-testing to solve everyday problems that arise in analytical and technical laboratories. The tabular summary of the limits of identification attained by spot tests gives a lot of essential information ready at hand.

The author and the translator deserve the best thanks of every student of organic chemistry for making available such a very useful book in Engish. The reviewer hopes that spot tests would be more widely used in laboratories in the near future. 'Spot tests' by Feigl should be on the shelf of every laboratory.

K. N. Menon.

Organic Peroxides. By Arthur V. Tobolsky and R. B. Mesrobian. (Interscience Publishers), 1954. Pp. x + 197. Price $ 5.75.

The volume under review deals with the preparation, properties and structural classification of various types of organic peroxides, extensive literature citations being included. Peroxides with the structures, ROOH or R_1OOR_2 where the R's may be alkyls or aryls, transannular peroxides of sterol, anthracene, naphthalene, etc., aliphatic and aromatic peroxy acids, peroxy esters, diacyl and diaroyl peroxides, etc., are briefly described with their preparation, properties and other relevant details. An organic chemist engaged in the preparation of organic peroxides and high polymer chemistry will find the details of various methods, chemical and physical, of estimation of various types of peroxides very handy and useful.

Eleven diagnostic tests for the detection of radicals from the decomposition of peroxides are described. Various steps in the thermal and photochemical decomposition of ditertiary butyl peroxide in vapour phase and in various solvents and the kinetics of spontaneous and induced decomposition in solvents of benzoyl peroxide have been dealt with at great length. The decomposition, in the presence of solvents of various peroxides leading to the setting up of chains, the ferrous ion induced decomposition of peroxides, the homolytic and heterolytic cleavages of the peroxides, etc., have been very instructively surveyed. The last chapter of the book contains details about the peroxides as catalysts and initiators of viryl polymerization, with a brief description of elementary steps and kinetics of viryl radical polymerization.

Chemists engaged in radical polymerization of vinyl monomers will find this book highly useful and interesting. The scattered data about the properties of peroxides especially as initiators

of polymerization have been collected and collated here for the first time and therefore the volume will prove a boon to high polymer chemists.

M. SANTHAPPA.

Methods of Biochemical Analysis. Vol. I. Edited by David Glick. (Interscience Publishers), 1954. Pp. x + 521. Price $ 9.50.

So many different methods of assay of biologically important substances and systems have been reported in scientific literature that one often finds it difficult to choose the best and the most authoritative among them. The volume under review is the first of what is designed to be an annual series publication, with the object of collecting together methods and techniques, which can be relied upon and which lay emphasis on recent developments. The selection of topics has been somewhat arbitrary, and one fails to see much of a connection between one topic and another, except perhaps, the broad classification under chemical determinations, paper chromatography, autoradiography, zone electrophoresis and ultracentrifugal analysis. But as this annual series is intended to be an encyclopedic treatment of various methods of biochemical analysis by experts in the respective fields, one may rely on Editor Glick and his internationally renowned advisory board for the judicious selection of topics, which will be of current importance every year.

The present volume deals with biochemical methods such as determination of sulfhydryl groups and phenolic compounds, microbiological assay of antibiotics and vitamin B_{12}, chemical determination of choline, and ascorbic acid, separation of steroids of the adrenal gland, assay of urinary neutral 17-ketosteroids, chromatographic analysis of radioactive iodine-compounds from the thyroid gland and body fluids, estimation of nucleic acids and determination of raffinose and ketose in plant products, as also the assay of catalases, peroxidases and hyaluronidase and the determination of adenosine triphosphate and related compounds, by firefly luminescence and other methods. In the treatment of each method there is generally a discussion of the background of previous work, and a critical evaluation of the existing procedure followed by a detailed description of the procedure recommended given in such a manner, that it will give complete information necessary to carry out the analysis. In some chapters, the exact manner in which special equipment can be rigged up have been given in detail. The volume on the whole should prove extremely valuable to all biochemists who are constantly faced with the problem of choosing the best method or technique in their research work. It should also find a place in the libraries of all institutions interested in research or the teaching of biochemistry.

P. S. SARMA.

Electro-Analytical Chemistry. By James J. Lingane. (Interscience Publishers, Inc.), 1953. Pp. ix + 448. Price $ 8.50.

This volume covers the wide range of subjects which can be included under the comprehensive title, "Electroanalytical Chemistry", the only notable omission being polarography. The existence of authoritative monographs on polarography provides the author with sufficient justification for its non-inclusion in this volume. For the same reason the practical aspects of analytical methods such as conductometry, pH measurements and potentiometric titrations do not receive the detailed treatment that they merit. In the chapters devoted to these subjects (IV to IX) the emphasis is more on the theoretical basis of these methods. The stress laid on the fundamental aspects of electrochemistry is a welcome feature of this book. Thus two chapters, II and III, are set apart for a consideration of the fundamentals such as electrical units and standards, measurement of E.M.F. theories of E.m.F., etc. Similarly Chapter X entitled "Electrolysis" deals with all aspects of that subject in detail. In Chapters XI to XVIII, one finds a highly informative account of the methodology and the specialized technique employed in electro-gravimetric analysis, internal electrolysis, electrographic analysis and coulometric analysis. Automatic instrumentation as described in Chapter XI has considerably enhanced the value of electro-gravimetric analysis, and the fact that the author has devoted three chapters (XII, XIII and XIV) to this subject is an index of the growing recognition of the importance of this somewhat neglected branch of electro-analysis.

Special attention should be drawn to the last two chapters (XVII and XVIII) which deal with the newest of all electrometric techniques —coulometric analysis in which the quantity of electricity required for a quantitative reaction is measured either by a coulometer or obtained by multiplying time with the constant cur-

rent employed for electrolysis. This is the first time that this subject finds its due place in a monograph.

A standard treatise on the subject, the volume must find a place in every analytical library. The format maintains the excellent standard of other Interscience publications.

A. P. MADHAVAN NAIR.

The Biochemistry of Brewing. By I. A. Preece. (Oliver & Boyd), 1954. Pp. 393. Price 25 *sh.* net.

The burden of maintaining contact with new developments in all aspects of biochemistry is indeed heavy today even for a professional biochemist. This burden falls all the more heavily on the industrialist interested in interpreting the observations made in the laboratory on the scale obtaining in the brewery, for instance. The book under review represents an attempt made by the author to bring together within the scope of a small volume all the useful information available in biochemistry and to apply it in modern biochemical terms to the raw materials and proceses involved in the manufacture of malt and beer. The attempt has been remarkably successful despite the gaps in our knowledge of the biochemistry of the raw materials used in the brewing industries.

The book deals primarily with the various steps entailed in the manufacture of good beer, and this would naturally call for detailed discussions on the stability and characters of beer itself, as well as the chemical compositions of the raw materials, the biochemistry of malting, mashing, copper boiling, fermentation and process control. In doing so, the author has not only brought together a large collection of established scientific facts and the practical viewpoints gained through the background of substantial empirical knowledge, but has pointed the way to the successful exploitation of both by science and industry.

The book is well printed and is remarkably free from errors. It is moderately priced and will be found useful by all interested in fermentation industries and biochemistry.

J. V. B.

Intermediate Zoology. By D. R. Puri. (S. Chand & Co., Delhi), 1953. Pp. 441. Price Rs. 9.

This book is adequate for the needs of the Intermediate students for whom it is meant. The author follows the time-honoured type system and starts with the study of the frog. The frog and the prescribed types are dealt with rather fully, and the main groups belonging to the rest of the animal kingdom are treated in a general and elementary way. The preliminary chapters deal with the basic facts of biology, and the two chapters following the account of the frog deal with histology.

The matter contained in the book and the manner of its treatment are satisfactory. However, in describing the life-cycle of the malarial parasite, no reference has been made to the stage when the parasite is in the liver of the human host; this is a serious omission. The homologies of the parts of the maxilla of the cockroach (page 214) are wrongly given. The emphasis on the so-called diploblastic nature of the Coelenterata and gastrula stage in development is out of tune with recent knowledge.

The language is in general simple and clear. There are some statements (like 'Man, for instance, was evolved from an ape', page 285; 'There is a gene for every character', page 361) which are misleading and should not find a place in any book, much less in an elementary text-book. There are several spelling mistakes, the majority of them occurring in technical terms. It is hoped that the next edition will be shorn of these defects.

The book is profusely illustrated, and the illustrations are neat and the parts are directly named in full. An exhaustive glossary of technical terms and an index are added at the end. The get-up of the book is good and leaves nothing to be desired.

M. E.

Survey of Biological Progress, Vol. II. Edited by George S. Avery Jr. (Academic Press Inc., New York), 1952. Pp. 333. Price $ 7.00.

The first of this series appeared in 1949 with a list of important experimental techniques covering eleven diverse fields of modern biological research such as Genes and Gene Action, Tracer Methods, Growth Hormones, and Ecological Studies on Populations. That volume was well received by the research worker as well as the amateur biologist. The present volume covers many other fields of modern biological research such as Effects of Radiations on Biological Systems, Progress in Human Genetics, Biological Oceanography, Morphogenesis in Plants, Plant Hormones, Histochemistry, Fine Structure of Protoplasm, and Physiology of Reproduction in Plants. Whilst the aim of these treatises is mainly to stimulate thinking in the specialist, it has, to my mind, an even greater function—it produces an integration of the different disciplines in science and reveals to the biologist the need for applying fundamental principles of the physical sciences in interpreting biological norm.

This volume has been lavishly produced with many rich illustrations, particularly excellent half-tone blocks of electron micrographs in the chapter dealing with the structure of protoplasm. The bibliography at the end of each chapter is exhaustive in most cases and is printed in alphabetical order, although there appears to be no uniformity in the matter of numbering the citations serially. In the chapter dealing with 'Histochemistry', the reviewer is surprised to find that no mention is made of chromatography among the methods used for its study, although in recent years it has become a vital analytical tool in the hands of biologists.

The overall view that one gets after perusing this book is that it provides specialised knowledge to all experimentalists, particularly, experimental biologists. It would, nevertheless, be appreciated by a much wider public, as there is enough material to satisfy their general scientific interests. T. S. SADASIVAN.

Bibliography of Soil Science and Fertilizers with Reference to India. By K. K. Guha Roy. (Issued as *Bulletin No.* 74, by I.C.A.R., New Delhi), 1954. Pp. iv + 131. Price not given.

The author who was formerly Librarian, Linlithgow Library, Indian Agricultural Research Institute, New Delhi, points out in his preface that in regard to the scientific study of soil and crops in India, the Imperial Bureau of Soil Science have been rendering signal service. But they started with the year 1931 leaving out the references previous to that date, and much information contained in the annual reports issued by the various Departments of Agriculture which are regarded as very valuable is not included in their purview. The author therefore undertook to compile a consolidated bibliography of all literature pertaining to India on soils and fertilizers so that the Indian research workers in this field might be aware of what has been achieved and what remains to be achieved. With this end in view the compilation of this bibliography was undertaken about 4 years ago, and has now been brought up to the end of 1942. The *Bulletin* is bound to be highly useful to workers on soil science and agriculture in India.

Books Received

Text-Book of Metallurgy. By A. R. Bailey. (Macmillan & Co.), 1954. Pp. viii + 560. Price 30 *sh.*

Semi-Micro Organic Preparations. By J. H. Wilkinson. (Macmillan & Co.), 1954. Pp. x + 94. Price 8 *sh.* 6 *d.*

Outlines of Organic Chemistry. By E. J. Holmyard. (Edward Arnold Pub. Ltd.), 1954. Pp. vii + 492. Price 16 *sh.*

Introduction to 3-D. By Dewhurst. (Chapman & Hall), 1954. Pp. xv + 152. Price 21 *sh.*

Statistical Analysis in Chemistry and the Chemical Industry. By Carl A. Bennett and Norman L. Franklin. (Chapman & Hall), 1954. Pp. xvi + 724. Price 58 *sh.*

Science and Civilisation in China, Vol. I. By Joseph Needham. (Cambridge University Press, London), 1954. Pp. xxxviii + 318. Price 52 *sh.* 6 *d.*

Gas Dynamics of Thin Bodies. By F. I. Frankl and E. A. Karpovich. (Translated from the Russian by M. D. Friedman.) (Interscience Publishers, Inc.), 1954. Pp. viii + 175. Price $ 5.75.

EXCHANGE OF SCIENTIFIC INSTRUMENTS

APPLICATION of a scheme to aid the international exchange of delicate scientific measuring instruments was announced on August 25, by UNESCO. Thirty-four Member States of UNESCO have expressed interest in applying the scheme and 19 of them have named a total of over 70 scientific laboratories as participants.

The UNESCO-sponsored scheme is designed to assure speedy and safe transit of scientific measuring instruments, exchanged between laboratories in different countries for purposes of comparison. The scheme involves use of an internationally standardized and recognized label on packages of instruments. With this label, carrying the distinctive UNESCO symbol, packages receive customs clearance at the sending or receiving laboratories rather than at customs depots, thus avoiding possible damage or delay.

UNESCO is to keep a register of laboratories designated by governments as participants and send member States information on its operation. The first information circular was sent on August 25, by the Director-General of UNESCO.

The International Bureau of Weights and Measures and the International Council of Scientific Unions have both endorsed the plan, which forms part of UNESCO's programme for the free flow of information.

SCIENCE NOTES AND NEWS

Wheat Culture

Prof. A. B. Saran, Bihar Agricultural College, Sabour, writes as follows:

In an experiment on wheat culture conducted at the College Farm, Sabour, the seeds were sown on ridges about 8" high and 9" apart. An increase in yield of 57·5 per cent. over the local cultural practice (seeds sown behind the plough) was observed. The experiment covered an area of 0·20 acre.

The author got the idea of sowing wheat on ridges from Japan, where he found bumper wheat crop growing on ridges in plots which had a rice crop in the preceding season. Grateful thanks are due to Dr. R. H. Richharia for providing facilities at the College Farm.

Prefixes for 10^6, 10^9 and 10^{12}

The International Union of Pure and Applied Physics in 1948 made a recommendation for names and symbols for the prefixes 10^6, 10^9 and 10^{12}. In 1951 the recommendation was stressed by a separate resolution at the Copenhagen meeting of the Union and it was repeated by the Conférence Générale des Poids et Measures. The recommended usages were: 10^6 = mega; 10^9 = giga; 10^{12} = tera; 10^6eV = MeV = mega electronvolt; 10^9eV = GeV = giga electronvolt; 10^{12}eV = TeV = tera electronvolt.

The Report to the Assembly of the Commission for Symbols, Units and Nomenclature, at the meeting of I.U.P.A.P. held in London during 7-10 July 1954, stated: "Notwithstanding the recommendations, the name BeV is still very much used, in particular by United States scientists, to denote 10^9eV, as an abbreviation for 'billlion-electronvolt'. This is very regrettable, not only because there is no reason to write BeV and not GeV, but mainly because of the well-known double meaning which the word 'billion' has: 10^9 in the United States, and 10^{12} in Europe. The prefixes mega, giga and tera, on the other hand, are *not* related to either the European or the United States names of numbers; they are derived from Greek words which mean respectively large, very large and monstrous. It is hoped that, in particular, scientists working in the field of high energy particles and machines will avoid the ambiguous word 'billion' and use the recommended symbols.

High-Speed Electronic Thermometer

A new electronic clinical thermometer which gives an accurate temperature reading in 5-7 seconds was demonstrated recently at the Army Medical Service Graduate School in Washington.

The electronic thermometer, known as the "Swiftem", has a thermistor (thermally sensitive resistor) attached at the tip of the delicate steel probe, replacing the old-fashioned glass mouthpiece. The recording meter and the mercury cell battery which supplies the power, are contained in a plastic case small enouguh to fit easily into the palm of the hand. It is operated by a finger button switch, and in appearance resembles a typical photographic light meter. Handpiece and thermometer are connected by a transmission cord. The length of the cord does not affect the sensitivity or accuracy of the instrument. The meter registers degrees of temperature in black figures below normal and red figures above normal. The steel probe is easily detached for sterilisation, and tends to eliminate breakage and loss. The electronic "Swiftem" represents the first change in clinical thermometers since the mercury column type was introduced in 1867.

New Solvent for Silk

A new solvent for silk is reported by Christopher Earland and David J. Raven in a recent issue of *Nature* (1954, 174, 461). It is found that silk is very readily soluble in formic acid containing small quantities of water and certain inorganic salts at room temperature.. Up to 20 per cent. (*w/v*) of silk may be dissolved in these solutions, which are then semi-solid. Salts which are effective for rendering silk soluble in formic acid include lithium chloride, bromide, iodide and thiocyanate, magnesium, calcium, strontium, zinc and manganese chlorides, and calcium and barium bromides, whereas the alkali metal halides are almost ineffective. The salt concentration is related to the water content of the formic acid. Thus, using 90 per cent. (*w/w*) acid, 10 per cent. (*w/v*) anhydrous calcium chloride is necessary, whereas with 98 per cent. formic acid, only 2 per cent. calcium chloride is required.

Upon dilution with water, followed by vigorous agitation, the silk is precipitated from formic acid calcium chloride solutions as a white curd.

Alternatively, the silk may be obtained as a film by spreading the solution on a glass plate, allowing the solvent to evaporate in a desiccator over solid sodium hydroxide, followed by washing with ethyl alcohol to remove calcium chloride.

Fourteenth International Congress of Pure and Applied Chemistry

The Fourteenth International Congress of Pure and Applied Chemistry will be held in Zurich, 21-27 July 1955. The Congress will cover pure and applied organic chemistry. A provisional subdivison has been made along the following lines: (1) Theoretical and physical organic chemistry (molecular structure, stereochemistry, reaction mechanisms); (2) Natural products (aliphatic and alicyclic compounds, including terpenes and steroids, carbohydrates, amino acids, aromatic and heterocyclic compounds, alkaloids, glycosides); (3) Synthetic, industrial and analytical organic chemistry (dyestuffs, plastics, tanning agents, synthetic resins, synthetic and analytical methods). The programme also includes five main Congress lectures.

Further particulars may be obtained from Dr. A. L. G. Rees, C.S.I.R.O., Division of Industrial Chemistry, Box 4331, G.P.O., Melbourne, or directly from Dr. Rudolph Morf, Secretary-General, Fourteenth International Congress of Pure and Applied Chemistry, Schonberggasse 2, Zurich, Switzerland.

Third International Congress of Biochemistry

The Third International Congress of Biochemistry is to be held in Brussels during August 1-6, 1955. The scientific programmes of the Congress will include (i) symposial sessions, (ii) sessions for members' communications, and (iii) general lectures.

There will be thirty-two symposial sessions devoted to the presentation (by invited speakers) of reviews upon tropical subjects. Subjects selected and the sectional arrangements are as follows: organic chemistry of substances of biological interest; chemistry and physical chemistry of proteins and polypeptides; chemistry and physical chemistry of nucleoproteins and nucleic acids; enzymology; intermediary metabolism; biological oxidations and oxidative phosphorylations; biochemical regulations; biochemistry of the cell; biochemistry of muscle and central nervous system; biochemistry of micro-organisms; plant biochemistry and biochemistry of the soil; chemical zoology; nutrition; chemical pathology; chemical pharmacology; clinical chemistry; industrial biochemistry.

Communications from members will be accepted whether or not they fall within the scope of the symposia and will be incorporated into sectional programmes. For further information please write to: General Secretary of the Congress: 17 Place Delcour, LIEGE (Belgique).

Indian Journal of Fisheries

The Indian Journal of Fisheries is a new periodical published by the Ministry of Food and Agriculture, Government of India. The Journal is to provide a medium for the publication of original contributions and critical reviews in the field of fisheres research, and would cover subjects relating to fishery biology, fishery technology and other scientific topics of direct and indirect bearing on the development of fisheries science in general and Indian fisheries in particular.

Each volume is expected to contain about 400 pages to be issued in two numbers. The two numbers of the first volume have been issued together.

The Editorial Board consists of the Fisheries Development Adviser to the Government of India, New Delhi (*Chairman*), the Chief Research Officer, Central Inland Fisheries Research Station, Calcutta-7, and the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp, S. India (*Managing Editor*). Contributions for publication may be sent to any member of the Editorial Board.

Fishery Biology and Fisheries in India

Dr. C. P. Gnanamuthu, Director, Zoology Laboratory, University of Madras, Madras-5, has been deputed by the Indo-Pacific Fisheries Council to serve as Bibliography Correspondent for cataloguing and collecting separates of different papers and notices published in India on Fishery Biology and Fisheries. Authors of papers on any topic relating to the above subjects are therefore requested to send separates or full titles of papers to him for transmission to the Indo-Pacific Fisheries Council.

Award of Research Degree

The Calcutta University has awarded the Ph.D. Degree in Chemistry to Shri Ajit Kumar Mukherjee for his thesis entitled "The Study of Co-ordination Complexes".

1476-54 Printed at The Bangalore Press, Bangalore City, by C. Vasudeva Rao, Superintendent, and Published by A. V. Telang, M.A., for the Current Science Association, Bangalore.
Editor: Prof. G. N. Ramachandran, A. C. College of Technology, Madras 25.